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UPPER BURMA, 1943–44

BRIGADIER BERNARD FERGUSSON

Evening Meeting of the Society, 29 October 1945

FOR TWO reasons I am conscious of a certain diffidence in reading the following paper before the Royal Geographical Society. First, my companions and I were engaged primarily on fighting the Japanese; and, being somewhat preoccupied with that aspect, we did not turn our opportunities to account. Secondly, the country and the experience were both new to us; so that we were not really qualified to know how much of what we saw and of what we experienced was new and original. Many travellers, such as Mr. Kingdon Ward, Mr. Kaulback, and Mr. Hanbury-Tracy, have covered far greater distances and spent much more time in the country. I therefore think I had best start by defining the area which we got to know so well, and by giving a very brief summary of the two distinct expeditions.

To travellers such as those whom I have mentioned, I fear that our stamping ground will seem rather surburban. When we talked about Upper Burma, we meant the area bounded on the west by the river Chindwin, on the north by the approximate area of Myitkyina, on the east by the Chinese frontier, and on the south by latitude 23°. That was our cockpit. The marches which we had to make in approaching or in disengaging from our enemy took us through different country, less well known to Europeans. For instance in 1943 a party led by Major Kenneth Gilkes disengaged by marching into Yunnan through the Kaolikung Hills, and in 1944 I led my brigade in over a part of the Patkai Hills which I believe not to have been previously traversed. But the country over which we fought, and which we got to know so well, was mostly country which was worked in peace time by one or other of the big timber firms. In shape it resembles an inverted horseshoe, surrounded on three sides by high mountains, and ridged internally by the valleys of the Irrawaddy and the Chindwin.

The first expedition led by the late General Wingate may be said to have lasted from 12 February 1943, when his first party crossed the Chindwin, until the middle of June of the same year, when the last considerable party reached

safety. The second can be taken as having begun in the first week of February 1944, when the 16th Infantry Brigade started over the Patkai Hills, and ended in August of the same year, when the last troops marched out through the American-Chinese lines near Mogaung. In those twenty months, there were thus only seven when the Japanese were wholly free from Chindit operations.

The scope and purpose of each year's campaign must be briefly described. In 1943, the force consisted of one battalion of British, one battalion of Gurkha, and one battalion of Burman troops. I use the word "Burman" in its widest sense, implying "inhabitants of Burma," for in actual fact there was only one Burmese in the whole expedition: the remainder were Kachin, Karen, or Chin. The original object was to further the projected invasion of Burma by our forces in India, by preceding them and harassing the Japanese defence by operations far behind their front line. Unfortunately the hoped-for offensive could not be mounted; and it was only after some pleading that General Wingate obtained from General Wavell permission to cross the Chindwin (the "Jordan" was our nickname for it) and to carry out our task unsupported.

Three months later, over 60 per cent. of the Force had returned safely. All had gone well until we allowed ourselves to be surrounded in that awkward triangle of rivers south and south-east of the junction of the Irrawaddy and Shweli. Hemmed in on three sides by Japanese and by the rivers, we had to break through the ring surrounding us by splitting into small parties. There were not enough wireless sets to ensure that supplies could reach us all; and there was a good deal of suffering on short commons. My own column's casualties were the heaviest. Out of three hundred and eighteen men who came in with me, only ninety-five got back to India. Of the remainder, some were battle casualties, some died of starvation or disease, some were drowned; one hundred and forty fell into Japanese hands, and of these one hundred and twelve died. Twenty-seven were rescued in Rangoon in May of this year, and one more has been found in Malaya, whither he was removed by the enemy. I give these appalling figures both to show what a beastly enemy the Japanese was, and to indicate why we were all so loath to become his prisoner.

The achievement of that first expedition was not spectacular but it provided useful experience. We learned a great deal about tactics, about the shortcomings (as well as the virtues) of the Japanese as a fighting man, about the military topography of the country, and about the enemy's communication system. We also proved that supply-dropping was feasible. On the credit side also we had some considerable damage to the Mandalay–Myitkyina railway; a number of dead Japanese; and the fact that we had put them off their stroke, and caused them to call off more than one projected operation.

So much for 1943. The year 1944 was a different affair altogether. This time we went in in great strength, and strongly supported by a private American Air Force with which we had been endowed by President Roosevelt. The President had been greatly shocked to learn that in 1943 we had had no means of getting out our sick and wounded, who had had to be abandoned if they could not walk. He therefore gave us no less than four squadrons of light aircraft which could land in under 300 yards on rough runways prepared in twenty minutes or half an hour, by removing the bunds (or *Kezins* as they

call them in Burma) from paddy fields. Although their primary function was the evacuation of wounded, they were also extremely useful for reconnaissance and liaison flights. In addition, we had a squadron of bombers and another of fighters, whom we came to know intimately during training, and whose work was integrated with ours to a degree never achieved elsewhere. We had also a magnificent corps of gliders and glider pilots, and a fleet of transport aircraft of our own. In fact, we were so well equipped as regards air forces that every column, except those of my own brigade, were flown into our combat area 150 miles beyond the Chindwin, amounting in all to something like fifteen thousand men and two thousand animals.

The 1944 campaign was in every respect more ambitious. Until the death of General Wingate in an aircrash, during the last week of March, the plan was to seize and hold the vital communications centre of Indaw. This little town on the railway was of great strategic importance. It is the northernmost point in Burma from which routes radiate in every direction. North of it, one is committed by the mountain ranges, which grow steadily in size the farther north one travels, to one route or another. From Indaw one has the choice of journeying westward to the Chindwin or the Mu Valley; eastward to the Irrawaddy at Katha by rail or road: southward by rail or road to the plains of the Dry Belt or northward by rail or road (the Japanese had built the road) up the narrow valley to Myitkyina. The railway was the line of communications supporting the Japanese 18th Division opposing the Chinese-American army of General Stilwell in the north, which was advancing slowly and painfully along the so-called Ledo Road, which it built as it went.

After General Wingate's death, the plan, no longer sponsored by his vigorous advocacy and endangered by the Japanese advance across the Chindwin, underwent a change; and our efforts were diverted towards helping General Stilwell reach the line Mogaung–Myitkyina. Under pressure from General Stilwell in the north and the Chindits to the south of them, and with their vulnerable supply line cut, the Japanese 18th Division was gradually strangled, and finally ceased to exist.

I would like to emphasize once again the difference between the two campaigns. That of 1943 was merely a raid, an unsupported foray, when we were vastly outnumbered, when our object was to emerge suddenly from the jungle, strike a swift blow, disappear again, and reappear later to destroy some new objective. However much we tried to persuade ourselves that we were the hunters, we ended by being thoroughly and most unpleasantly hunted. In 1944, by contrast, we were present in great strength, prepared and able to fight pitched battles. In both years, rivers and mountain ranges were our great obstacles, particularly the former, and the study of topography was vital.

The basic unit was the column, of approximately four hundred men and sixty animals. Each man carried a load of seventy pounds, which is half the weight of the average man. He was armed with rifle, bayonet, grenades, and the broad-bladed Burmese knife, about 18 inches long, known as a *dah*. Also in the column were Bren guns, mortars, Vickers machine-guns, and, in 1944, flame-throwers. These heavier weapons were carried on mules until the moment of battle.

The needs of a guerilla soldier are surprisingly few. They are: food, water, ammunition, information, and health. The great mistake which we made in 1943 was in providing insufficient food. Lack of food undermines morale quicker than any other enemy. From the moment we left roadhead we were hungry: and except for a few days when, on the way home, we came under the protection of the Kachins, we never had an adequate meal. At best the daily ration was eight biscuits, one ounce of cheese, half a pound of nuts and raisins, and half a pound of dates, in addition to tea, sugar, and milk. In theory we eked it out with rice and game; but in practice this did not work out. We were often unable to forage, either owing to the presence of Japanese, or to the need for remaining concealed. Sometimes also we were in areas remote from villages. As for hunting game, this was rarely possible. We were always in a hurry, and a column on the march, however cautiously it may be moving, will make enough noise to scare away any beast.

Much time has been wasted in teaching the doctrine that a man who knows what is what in the jungle can subsist on edible roots. This may be possible in certain jungles at certain seasons, but it is a whole-time job, and it is nonsense to suggest that troops can carry out their job, cover their daily distance, and fight the enemy, on what they can find in the jungle. I feel bitter about this, because at one period my men and I subsisted for eleven days in the dry and dusty jungle, near the mouth of the Shweli, on three mugfuls of rice, two malted milk tablets, and a lump of pork about the size of a golf ball for each man. Natives with us were as baffled as we ourselves, and none of the familiar edible roots were to be found. The greatest deprivation of all was undoubtedly sugar. I am quite prepared to accept the medical doctrine that salt is a greater need; but in those extremities one does not crave for it as one does for sugar. That desire becomes almost tangible; it torments one with hallucinations; it paralyses one's very tongue. The first mouthful of sugar after a long abstinence releases one from a bondage which those who have not known it can never appreciate.

Twice in this war I have seen troops go practically crazy for lack of water. The first time was in the Syrian campaign in 1941; the second was in Burma in 1944. Near Indaw, at the end of March, two of my columns assaulting a Japanese position across 10 or 12 miles of waterless jungle, failed to carry it, and were forced to withdraw for lack of water. The Japs fully appreciated the situation and, using motor transport, occupied all the water-holes in the area. The only stream in the neighbourhood ran between fields of open paddy, which were swept by machine-gun fire. Some of the troops were killed when their craving for water drove them across the paddy to the stream, even though they well knew that to venture on to the paddy meant certain death.

Around Indaw in March and April running streams are few and far between. One can gauge with some certainty from the map which streams dry up, from the absence of villages along their banks. Sometimes, high up on the hillsides, one may find pools, and sometimes, particularly at corners where the course of the stream has been diverted by a rock formation, one can detect a certain stickiness in the sand which indicates that it is worth while digging. It is a slow job, though, and means a wait of an hour or two even after reaching the water, while the sediment settles. The mules have to be kept away from

Mixed deciduous forest, Katha district

Bamboo jungle

Teak forest

Dense lentana and creeper, Katha district. A track is being cut

it, since if they once get the smell of it they rush in and trample down the water-hole won by hours of patience. Incidentally, on the occasion I have referred to above, near Indaw, the animals of those columns went for five days with only one drink; and only one—a pony and not a mule—succumbed. A number were killed when, maddened by the smell of water, they broke away from their muleteers and galloped across the paddy to the stream.

I have said enough to show that an appreciation of the water situation is very necessary when operating during the last two months of the dry season. This applies particularly to the teak forests. At this point I will break off to discuss the different types of jungle from the point of view of the war-time traveller.

For campaigning, teak forests are admirable, since it is possible to travel in any direction owing to the lack of undergrowth. In proper teak forests which have never been felled, the only undergrowth is the teak seedlings themselves. These grow to a height of about 2 feet, with huge leaves like rhubarb leaves, and with soft stalks which are easily trampled. Visibility extends to about 100 yards. In February and early March teak jungle makes delightful marching. After that, the leaves are off the trees, there is no shade, and the forests are intolerably hot and dusty.

Whatever type of jungle you are in, you always pine for another—until you get it. Most of all I dislike dead bamboo. It blocks the path in every direction, it is exceedingly hard to cut, and a dah becomes blunt after a dozen strokes. Green bamboo is better, and travelling is sometimes fast under its green archways. But unfortunately the arch is usually just too low for the mule's head, and then it has to be cut. Too often the result of a cut, however skilful, is that the whole arch falls, and you are confronted with a tumbled mass of greenery to clear.

Dense evergreen jungle is a nightmare: every foot of the way has to be cut, and I have known my speed, even without mules, to be reduced to less than ½ mile an hour. With loaded mules the position is worse: they require a track 6 feet high and 5 feet broad. The job of track-cutting is exhausting, and the "slashers" have to be frequently relieved. The system is for the leading men to cut a track wide enough for themselves, and for those coming after them to widen it gradually until the full breadth is reached.

I suppose no jungle is really impenetrable. General Wingate once issued a very characteristic order: "No patrol will report any jungle impenetrable until it has penetrated it." But some jungle is certainly so thick as to make it not worth while trying to negotiate. Such an area is that on the east side of the Chindwin east of Tamanthi and north of the Uyu. I have never met anybody, European or native, who has crossed it: although I know three who have tried. I have flown over it twice, and any crossing would be seriously complicated by several escarpments which look to me to be virtually unscalable. The escarpment known as the Zibyu Taungdan, running from the Chaunggyi southward, is nearly so. Coming out of Burma in April 1943 troops took two days to clamber up it, unimpeded by mules.

I would certainly never try to negotiate either prickly bamboo [1] or elephant grass, unless preceded—or pursued—by an elephant. Luckily neither of these is abundant, and they usually exist in small patches, which can be outflanked.

[1] I understand that this is really a species of palm.

In all cross-country travel the principle should be to make for the watershed and travel along it. Here the jungle is usually thinner; and along the top of it there is almost always a game track. In spite of possible trouble in reaching water, the watershed principle is sound. It often pays to make a detour of one or more days, depending on the length of your journey, in order to reach a watershed and to travel along it instead of across the grain of the country.

Cross-country travel is always slow, and we travelled by track whenever we were in a hurry and whenever we were confident that we could travel faster than the news of our journey. This implied a knowledge of the enemy; which brings me on to the next great need of the guerilla fighter: information. (I have not dealt with ammunition because the need for it is obvious. We always carried far too much ammunition until we learnt that replenishments from the air worked.) In our type of warfare, the least valuable information was that which came from our own headquarters in a sealed envelope. We had our maps, and although they were often inaccurate it was surprising how good they were. But all the most important information we had to get for ourselves, and we got it principally through our Burma Rifle Scouts. Far too little is known in this country of the part played by these troops. There were very few of them, less than a thousand in all. They left their homes to come out to India in 1942, and came back into Burma with us twice in the years that followed. They had only to don native dress and go home if they wished; but they willingly returned to India each time. They were our eyes and our ears, and we owe them more than we can say.

In 1943 each column had fifty; in the following year a dozen to each column was all we could afford. They were mostly Karen or Kachin; but in 1944 two of my columns had Burmese, who did very well. They would go into villages and pick up the gossip; and contrary to opinion in India, we found local information exceedingly accurate up to a range of 8 or 10 miles: beyond that it would get a bit distorted. We found local information 100 per cent. accurate about enemy on the move, but it tended to exaggerate enemy who were static. There is nothing surprising about this. Living in Aldershot, it would be difficult to assess how many troops were there; but if they all marched past a given point it would be easy to get a fair idea.

Altogether we traversed areas belonging to four different races. First, there were the Nagas. Some of those living near Manipur were reasonably civilized. The wildest I saw were in the Patkai Hills. Here they are still completely unadministered, and in fact we were the first Europeans they had seen. They wore only a blanket and beads, and had quills in their hair, and were not good-looking. Head-hunting was still prevalent, and they kept asking us to help them against each other. We captured a Japanese document from a junior officer to a senior explaining patiently that it was impossible to organize the Nagas against the British, as each village only wanted to be organized against its neighbour.

The Kachin villages are set on the hill-tops. They grow their rice on the hill-sides, enough only for their own use. Unlike the provident Burmese, who keep quantities of rice all ready for consumption, the Kachins husk only

Column on the march near Kamkam Bum, between the Chindwin and Uyu rivers

Mixed evergreen jungle

Indaing forest and undergrowth, Katha district

Government reserved indaing forest with self-planted seedlings

enough for their day-to-day use. They dress in black silk-like clothes, and the women wear head-dresses of the same stuff. There were missions before the war in Lonkin and Sumprabum, but for the most part they remain nat-worshippers, animists; and on all the tracks leading into the villages you find their little offerings lodged in a wicker tray or swinging in the wind. They are thoroughly unpopular with their neighbours in the plains, as it was their wont to plunder them freely and often.

Cases of Kachins cooperating with the Japanese were exceedingly rare. The only serious instance was the Kansi Duwa, a big chieftain near Lonkin, who had fallen out with the British some years before the war owing to some dispute over the royalties from his jade mines. But in the main the Kachins waged a fierce and unrelenting war against the Japanese. The doings of the Kachin levies around Sumprabum are well known. Down in our area the Kachins were more exposed to Japanese vengeance than in the far north, but they were the staunchest allies we had, and in the miserable march out of Burma in 1943 we had no qualms whatever about sleeping in their villages without posting a single sentry. In 1944 we armed numbers of them; and I remember in particular one boy aged not more than fourteen who single-handed attacked a Japanese patrol at its midday meal, killed three and sent the rest flying.

The Burmese in Upper Burma are only to be found along the Irrawaddy and the railways. I found them hard to distinguish from the local type of Shan and Shan-Kadu. They were friendly enough, but the only occasion on which I have absolute proof that we were denounced to the enemy in 1943 it was Burmese who were responsible. In fairness to them, their position was exceedingly difficult, as the punishment for failing to denounce us was torture and death.

The vast majority of the country which we traversed was peopled by Shan-Kadu. Like everybody else, they feared and hated the Japanese; and they feared us because they knew that to have dealings with us laid them open to the enemy's vengeance. Yet they helped us as they could, with foodstuffs and information.

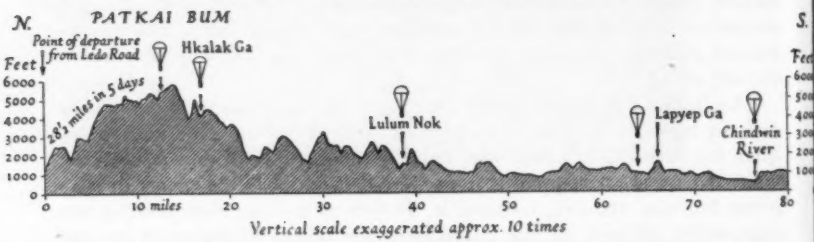
We worked chiefly from ½-inch maps. It was remarkable how accurate they were in detail, although much of the country had been surveyed only from the air. The task of the cartographer in Burma is not made easier by the habit of the natives of shifting their villages every ten or fifteen years. With the village, the whole local system of tracks naturally shifts as well. We realized early that we must accept accuracy only in natural features, such as contours and streams; and not to rely too much on finding man-made features, such as villages or tracks, where the map showed them to be.

In some of the wilder country even the natural features were apt to let us down. Some areas were shown white on the map, others were liberally studded with question marks. One surprising feature however was boldly shown without a question mark, which it obviously deserved. This was a stream called the Puk Yu, which was shown as rising in a range on the south side of the Patkai Hills. It flowed downhill, gaining in thickness and importance; and then surprisingly flowed uphill again, culminating in a source near

the top of another range. Odd as the country was, it was hard to believe that it was as odd as all that.

The first year we tended to avoid villages except when we needed food or information. The second year, confident in our enhanced strength, we passed through them freely, and often bivouacked near them, so that our Burmese speakers had leisure to drink in gossip and pour out propaganda. It was probably largely due to this that the incidence of malaria was far higher the second year, than the first.

That brings me on to health, the last of the five primary needs of the guerilla soldier. We relied entirely on suppressive tablets for our immunity from malaria, taking one every day. Once a month we took three a day for a period of five days. Although not a certain protection against the very high infection in our blood, the suppressive tablets did much to keep malaria within reasonable limits; and in defiance of medical practice and precept we refused to regard malaria as grounds for going sick. In 1944, with evacuation possible, men's staying powers were definitely inferior to the standard of 1943,



Profile of 1944 route over part of Patkai Bum to the Chindwin. Parachutes indicate supply drops

when evacuation was impossible. In those circumstances, as General Wingate said in his report, "men not only did not go sick: they did not even feel sick."

Minor troubles which easily became major unless they were watched were jungle sores and footrot. Both were due to carelessness: the latter through failing to let air get to feet which were invariably in wet socks (because it was normal to splash through streams twenty times a day). I managed to stamp out jungle sores by making it a punishable crime to have one, unless you could produce a medical certificate to say that you were not to blame.

It is impossible to say what an average day's march would be in terms of miles, since it depends entirely on the nature of the going. In 1943, including the last month, when we had abandoned the animals, we averaged about 90 miles a week over the whole period. In 1944 our average was very much lower, partly owing to the long, slow pull over the Patkai Hills, and partly owing to the fact that we spent far more time in static warfare. It is wiser to speak in terms of hours of marching. In the Patkai Hills I took five days to cover 28½ miles, and reckoned I was doing well.

I have mentioned several times our march over the Patkai Hills in February 1944. It was quite the hardest march I have ever done, and quite the worst

country I have ever seen animals go over. A few details may be of interest. I chose to go in by that route because the Japanese were watching the Chindwin very closely since our activities of the previous year. Although we might have managed to cross the Chindwin I feared we were certain to be held up on the Zibyu Taungdan escarpment, where it would be easy for the enemy to hold the few and narrow routes across it. I flew up and down the Chindwin many times, and interviewed many people of all races with any knowledge of the country. The only one who held out any hope was an American serjeant, who had been over a little of the country the previous year. We backed him against more expert opinion, and he turned out to be right.

I despatched a sapper major a fortnight ahead of me, with a force of a hundred and fifty sappers and fifty infantrymen, to find and improve on the track. It was in occasional use by Nagas, of whom we met one or two parties on the way. It took off from General Stilwell's Road at the ninetieth milestone from Ledo, at a place called Tagap Ga; and it began with a heartbreaking climb of some 2000 almost vertical feet. Working flat out we averaged 4 miles a day.

The Chindwin was a welcome sight when at last we reached it on the morning of February 29, after splashing 4 miles knee-deep along a tributary. We crossed it some 10 miles above Singkaling Hkamti, where there was a small Japanese garrison. This we had enticed away by landing a small patrol by glider on a sandbank some miles still farther downstream, and thus diverting their attention. From then on we knew we were sure to reach the Indaw area, because one of our parties coming out the previous year had reported a good track all the way. They had hit the Chindwin at Singkaling Hkamti, and from there gone downstream by raft 90 miles to Tamanthi.

I repeat what I said at the beginning of this paper: that I am well aware (and nobody is more ashamed of it than myself) that we failed to make proper use of the situation in which we found ourselves, wandering about in this highly interesting but little-known country. Exploration in the future can be made very much easier by such aids as we enjoyed. Supply-dropping is the most obvious; glider towing and glider-snatching could also be useful. For instance, when we reached the Chindwin river some miles downstream from where it emerges from the Kyaukse Rapids, gliders landed on the shingle-bank on the far side of the river, and disgorged motor-boats for us, complete with fuel and engineers to work them. These had been towed all the way from Hailakandi in Assam, a distance of over 200 miles.

It would be enthralling one day to go back on our tracks, and to journey through the same country at a more leisurely rate, without having Japanese to distract us. I have a large $\frac{1}{4}$-inch map of the area, which I often look at, and which brings back very many memories, some of them pleasant and some of them much otherwise. Most vividly it brings back the memories of some very fine men whom we had the misfortune to lose during these two campaigns.

DISCUSSION

Before the paper the PRESIDENT (The Rt. Hon. LORD RENNELL OF RODD) said: To-night you are to hear of Burma. Brigadier Fergusson, now of the Headquarters of Combined Operations, is going to speak on that subject and to show

some pictures of the Burma campaign, or rather of the Wingate campaigns. This is not an account primarily of geographical work done in the field; it is rather an account of the effects of geography on the conduct of the campaign. This campaign will be remembered and associated in many of your minds with General Wingate, who started on his momentous career with the patriot campaign in Ethiopia and lost his life in Burma. But this should not obscure the major issue in Burma, which was the reconquest of Burma by the 14th Army, one of the most important and dramatic features of the war against Japan. It is a matter of great satisfaction to all of us that Burma was liberated, not by the capitulation of the Japanese but by its re-conquest, by the gallantry and skill of our men on the ground and by the assistance of the Anglo-American air forces in the skies. I now ask Brigadier Fergusson to address you.

Brigadier Fergusson then read the paper printed above.

The PRESIDENT: You have heard from Brigadier Fergusson an extraordinary account of a part of a military campaign; you have heard of the great things that have been done by those who innovated this type of warfare, and also the limitations of it. It remains for me to thank Brigadier Fergusson, on your behalf, for a very interesting and entertaining account of a part of one of the most arduous campaigns in which our Army has fought, told with all that good humour which conceals so much of hardship and of courage.

94°
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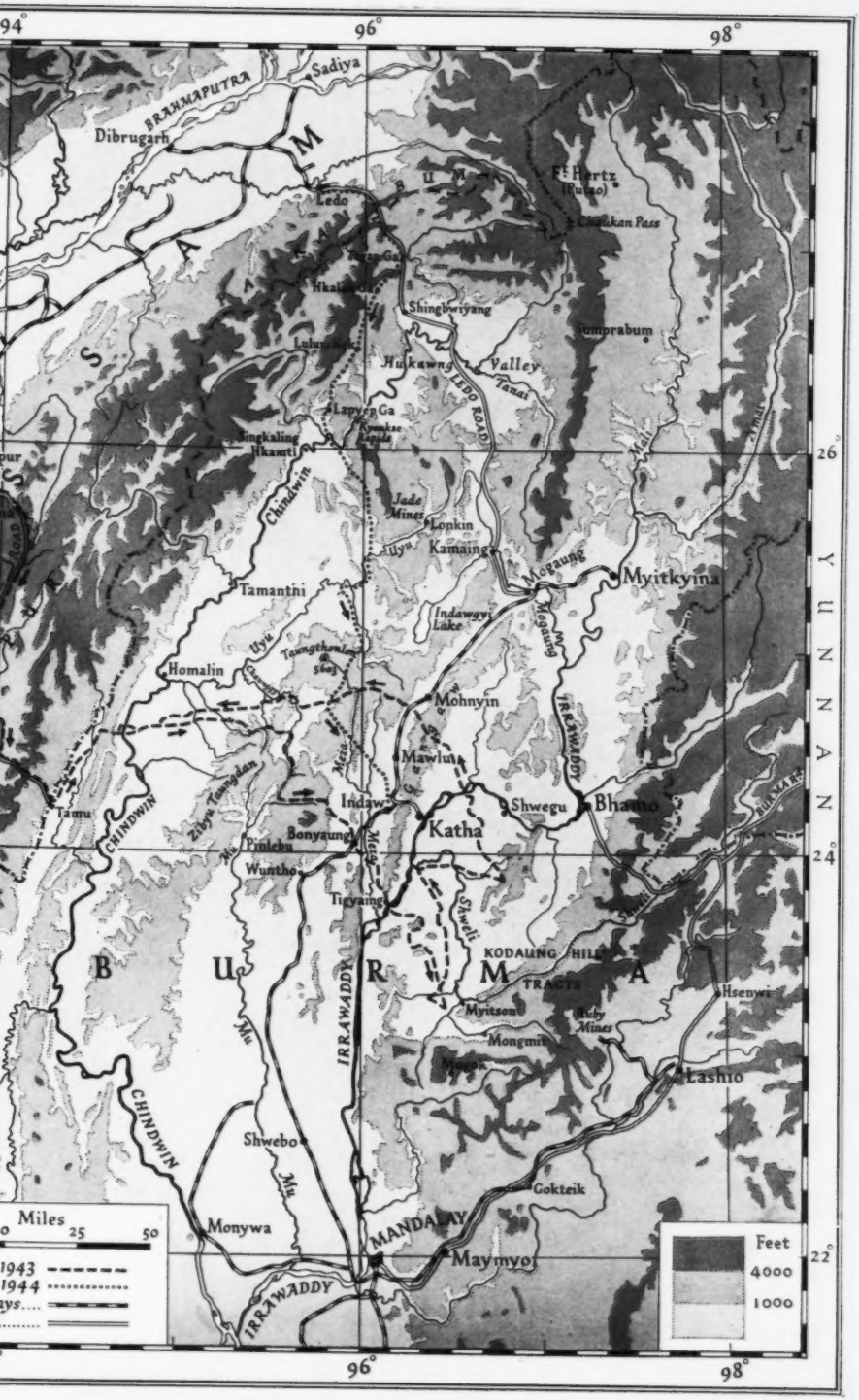
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Hkalak
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Sumprabum
Lulumkwa
Hukawng Valley
LEDO ROAD
Tanai
Lazwa Ga
Singkaling Hkamti
Chindwin
Jade Mines
Lonkin
Kamaing
Uyu
Mogaung
Myitkyina
Tamantni
Indawgyi Lake
Homalin
Taungthonlon
Mohnyin
Mawlu
Indaw
Shwegu
Bhamo
Tamu
CHINDWIN
Zibyu Taungdan
Bonyaungbin
Pinlebu
Katha
Wuntho
Tigyaing
Shweli
KODAUNG HILL TRACTS
Hsenwi
Myitson
Ruby Mines
Mongmit
Lashio
Shwebo
Gokteik
Monywa
MANDALAY
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BURMA
YUNNAN
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RESEARCHES ON SNOW AND ICE, 1918–40

H. W. AHLMANN

Afternoon Meeting of the Society, 12 November 1945

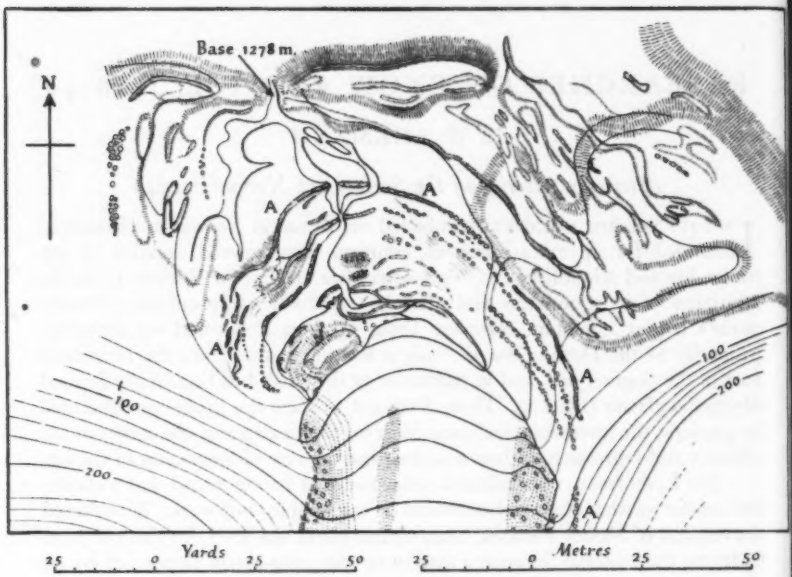
IN 1916 THE first world war compelled me to use in Norway a scholarship intended for an extra-European country. This proved decisive to my future life and scientific work. Very soon after arriving in Norway I felt the attraction of its mountains and glaciers, especially of Jotunheim, Scandinavia's largest mountain complex. From 1918–22 I devoted my attention primarily to the Horung massif, only a few kilometres from the innermost part of the Sogne fjord, and in particular to the small but beautifully formed Styggedal glacier (Plate 1). There I set out to learn the problems presented by glaciers: the meteorological conditions for their existence, the causes of the advance and regression of their margins, and the rate of movement of the ice.

Jón Eythórsson, my Icelandic colleague, and I soon found that a station for regular weather observations would be essential for our work. We selected the summit of Mount Fanarâk, 2020 metres above sea-level, for this purpose. Carrying the material for such a station up the 1000-metre slopes was by no means easy, more especially as none of the local farmers were willing to help us, convinced as they were that at that altitude any building would be wrecked by the winter storms. With the aid of two Norwegian students however Eythórsson and I managed to put up a small observation hut on the summit. As it withstood the storms of the first winter, the mountain farmers were won over and continued the work of construction. Later the Bergen Meteorological Institute took control and extended the building.

After a year or two the first high mountain observatory was ready, complete with an oil-driven dynamo for electric lighting and wireless equipment (Plate 2). The life of an observer there in the winter is not altogether a pleasure however as the humid winds from the Atlantic deposit enormous quantities of hoare-frost which, with the snow, threaten to bury the buildings completely. Plate 3 shows what this observatory looked like one Easter when no one had been staying there to combat the daily accumulation.

A very fine series of terminal moraines exist in front of the present margin of the Styggedal glacier (Fig. 1). These are divided into two series: the inner is bare of vegetation, while the outer is covered by grass and bushes. At the end of the eighteenth or beginning of the nineteenth century, when most Norwegian glaciers were much farther advanced than at present, it appears that the Styggedal glacier extended to the large moraine separating the two series. It has been demonstrated that this advance marked the maximum extension of the Styggedal and other Norwegian glaciers after the melting of the inland ice. As local glaciers they have at no time been any larger.

During the years of my investigations the margins of the Styggedal glacier were stationary. It was then in equilibrium: that is, its accumulation, or the annual supply of nourishment in the form of snow and hoare-frost, equalled



A.....A . *the moraine separating the two series*
Contours at 20 metres interval above Base

Fig. 1. Terminal moraines of the Styggedal glacier

the ablation, or the quantity of water removed from it by melting and evaporation. Since the beginning of 1930 however the glacier has been retreating more rapidly every year. The other Norwegian glaciers have been retreating also: some have practically disappeared. Fig. 2 shows the marginal movements of the arms of the Jostedal glacier, some 20 kilometres west of Jotunheim, the

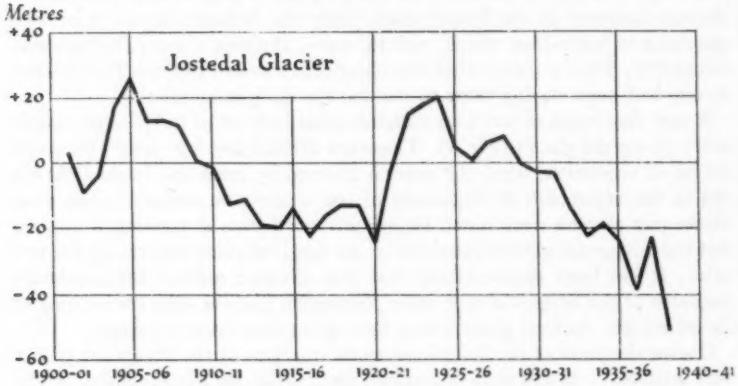
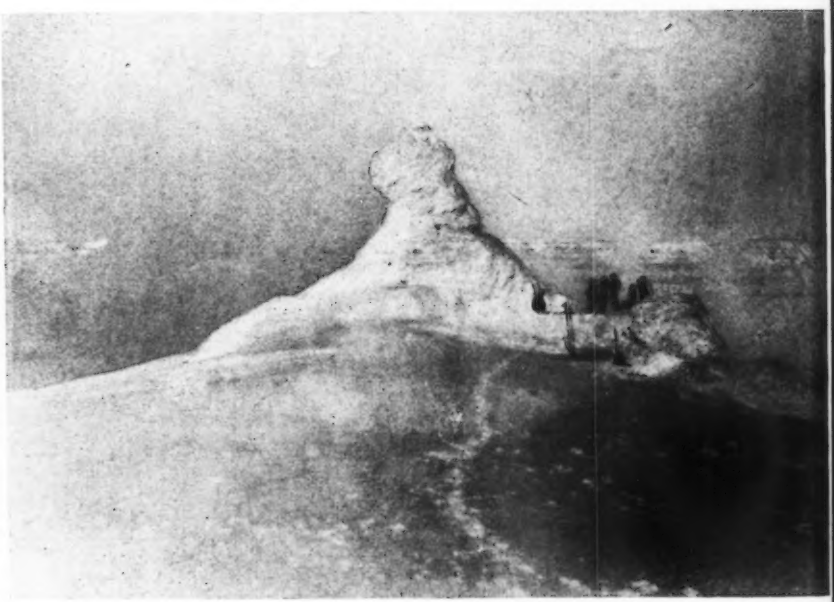


Fig. 2. Marginal movements of the arms of the Jostedal glacier

1. Styggedal glacier

2. Mount Fanaråk observatory



3. Mount Fanaråk observatory buried in snow

largest single ice mass on the European continent. If the regression of the last fifteen years continues for another decade or so it will be catastrophic for the Norwegian glaciers. This regression, to which I shall be referring re-

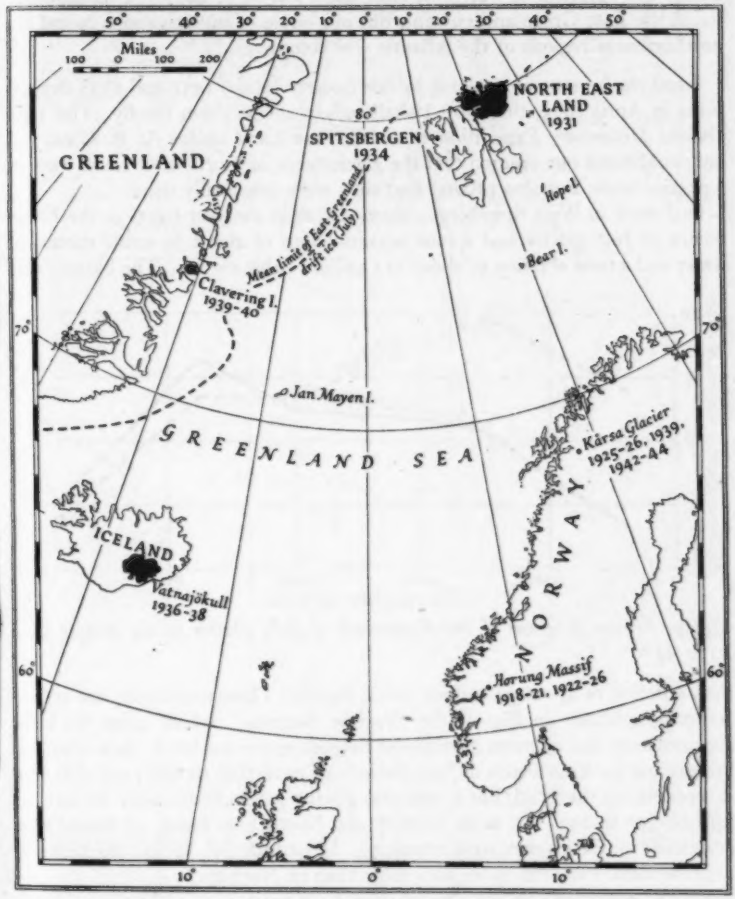


Fig. 3. Districts examined between 1918 and 1940

peatedly, is a result of what has been called the "recent climatic improvement," or "heating of the Arctic."

Our work in Jotunheim and the discovery in 1930 of the last camp of the Andrée Balloon Expedition of 1897 on White Island, caused me to choose North-East Land for the 1931 Swedish-Norwegian Arctic Expedition (Fig. 3). This expedition led to the Norwegian-Swedish Expedition to West Spitsbergen in 1934, with Professor H. U. Sverdrup, which in turn was followed

by the Swedish-Icelandic work on Vatnajökull in 1936–38, and finally by the Swedish-Norwegian Expedition to north-east Greenland in 1939–40. From this expedition I returned to Ålesund in Norway on 31 August 1939, the day before the outbreak of war. Our ship, the *Polarbjörn*, had been damaged by ice in the East Greenland current, but our circle of investigations round the northernmost regions of the Atlantic was complete.

I had the honour of speaking to this Society on the 1931 and 1934 expeditions in April 1935, therefore I shall only mention them briefly. The 1936 Oxford University Expedition to North-East Land under A. R. Glen, not only confirmed our opinion that the glacier caps of North-East Land were in a passive state, but also proved that they were practically dead.

Our work in West Spitsbergen showed that in the year 1933–34 the Fourteenth of July glacier had a total accumulation of about 79 cubic metres of water and a total ablation of about 113 million cubic metres. The balance was

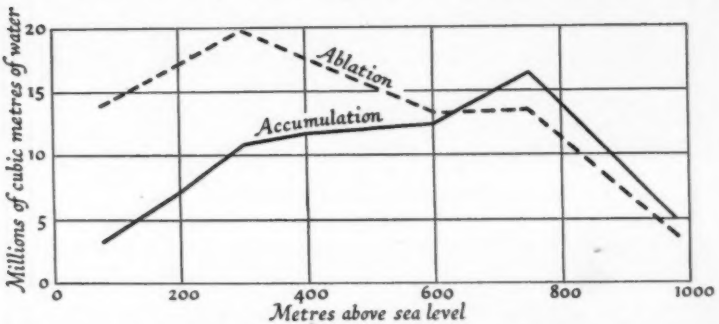


Fig. 4. Regime diagram of the Fourteenth of July glacier in the budget year 1933–34

thus a deficit of about 34 million cubic metres. These conditions are represented graphically in Fig. 4, the "regime diagram," which gives the total accumulation and ablation at different heights above sea-level. As a result of this regime the Fourteenth of July glacier was retreating rapidly; not only was it receding up the fjord, but it was also getting generally thinner. In fact, in Spitsbergen in 1933–34, as in Norway and North-East Land, we found that practically all the glaciers were retreating. In latitude 79°–80° N., the climatic improvement was even more noticeable than in Norway.

We had equipped our 1934 Spitsbergen headquarters as a laboratory. Here Professor Sverdrup carried out very detailed investigations of the dependence of ablation on solar radiation and convection, or the supply of heat through the atmosphere. His results indicated that 56 per cent. of the ablation was due to radiation and 44 per cent. to convection. The importance of convection decreases with altitude and increases with the progress of the ablation season: it is slight in the spring, increases gradually in the summer, and is dominant in the autumn.

In spite of the proximity of the ocean, the climate of north-west Spitsbergen

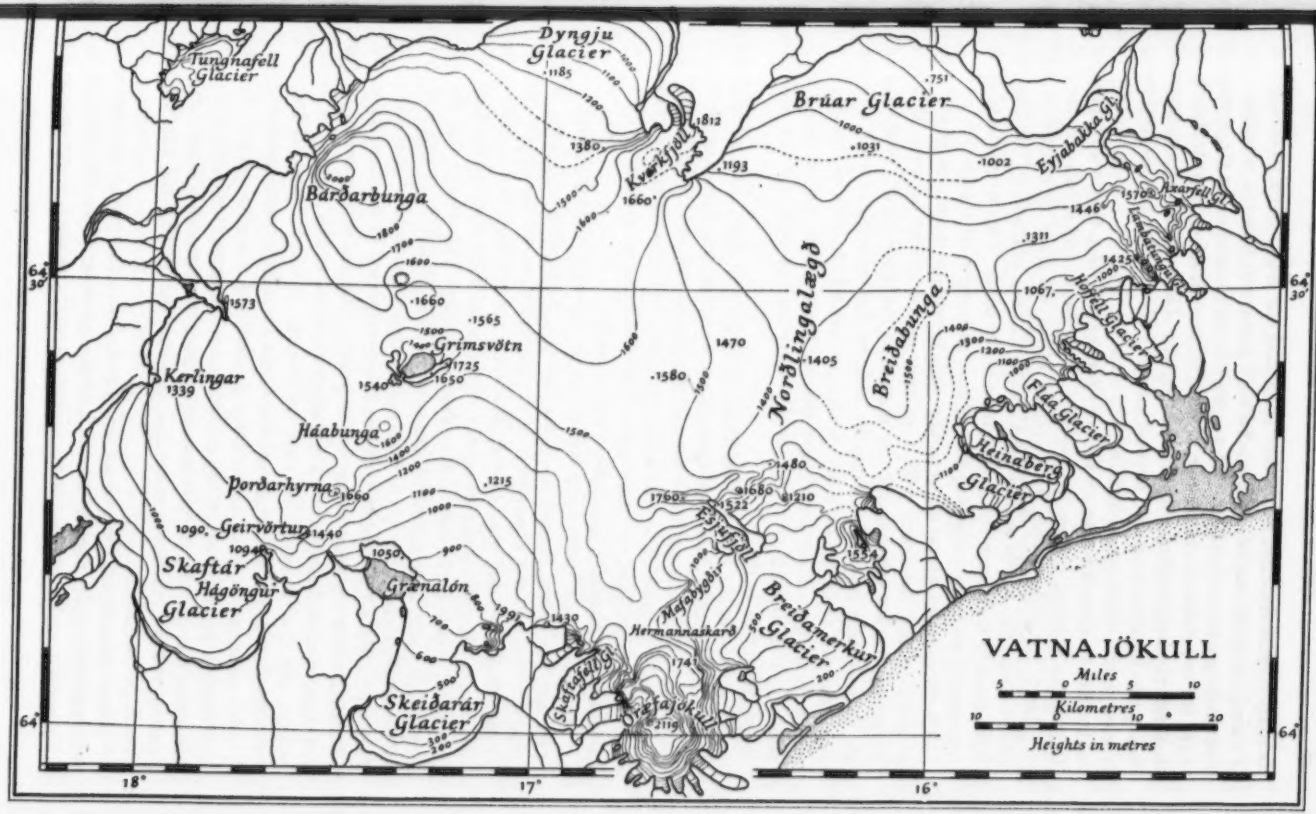

Dyngju Glacier
Tungnafell Glacier
Brúar Glacier
Eyjabakka Gl.
Bárðarbunga
Kverkfjöll
Grímsvötn
Kerlingar
1339
Háabunga
Þórðarhyrna
Geirvörtur
Skaftár Hágöngur Glacier
Grænalón
Skeiðarár Glacier
Skaftafellsjökull
Sígjá
Hermannaskarð
Breiðamerkur Glacier
Norðlingalægð
Breiðabunga
Heinaberg Glacier
Fláa Glacier
Hofell Glacier
VATNAJÖKULL
Miles
Kilometres
Heights in metres
64° 30'
64°
18°
17°
16°

Figure 5

is more continental than maritime. To extend our work, Jón Eythórsson and I wanted to study the life and condition of glaciers in a purely maritime district with great precipitation and a relatively mild climate. In the spring of 1936 we were able to realize our dreams of an expedition to Vatnajökull, in Iceland, the largest glacier in Europe (Fig. 5). There we found our hopes of heavy precipitation answered beyond measure, and we only just escaped being buried in the enormous snowfalls.

Another reason for our choice of Vatnajökull was that the subglacial Grimsvötn volcano, on the west side of Vatnajökull, had erupted at the end of March 1934. As a rule its eruptions throw up large quantities of ash, which cover the whole surface of Vatnajökull. We planned to use this ash layer as a key horizon in the stratification of the snow. This would be of great importance when investigating the regime, or budget, of the glacier.

The Grimsvótn eruptions generally melt enormous quantities of ice. The melt-water and the water which collects in the crater between different eruptions, force a way beneath the margin of the Vatnajökull, swamping all the surrounding land. The water let loose by the subsequent 1938 eruption was estimated to be 50,000 cubic metres per second. In view of the extent to which the 1934 melting would have affected the west side of Vatnajökull, we selected Hoffellsjökull (Fig. 6), on the south-eastern side, for our detailed investigations in 1936.

We arrived at the foot of Hoffellsjökull as early in the season as April 26. With the assistance of the local farmers, we spent the next few days taking our equipment up the steep lower sides of the glacier. We had a foretaste of the enormous precipitation on Vatnajökull at Camp VII, about 1229 metres above sea-level. From May 11–17 we were smothered by snow and rain, with a total downfall amounting to 336 millimetres of water.

We pitched our main camp somewhat to the west of Hoffellsjökull. Our first task was to find the ash layer from the 1934 Grimsvötn eruption. At that time no one had any conception of the precipitation on the upper parts of Vatnajökull. We dug pits, even as much as 5 metres deep, but could find no ash layer. Moreover the consistency of the snow forced us to conclude that it had all accumulated during the previous winter. This meant that the precipitation must have exceeded 2500 millimetres of water. It was not until Camp XIV, right at the top of Vatnajökull, that we succeeded in reaching the ash layer. To our joy a thin, coal-black layer appeared in the core of the drill, 8 metres below the snow surface. The profile indicated that since the autumn of 1935, 2600 millimetres of water had accumulated in this spot in the form of snow, and that a residue of 1500 millimetres of water remained from the winter of 1934–35. The 1935 autumn surface was easily distinguishable.

By continued digging and drilling we obtained a general idea of the distribution of precipitation on the glacier, and at the same time of the accumulation and the quantity of snow remaining after the summer ablation. We also put up stakes in the ice or snow against which the melting and accumulation could be measured.

From May 22 to June 18 we spent our time making journeys across the Vatnajökull, again digging pits and taking measurements. On June 18 Jón Eythórsson and I returned home, riding across the *sandars*, or outwash gravel

plains, west of Vatnajökull to Reykjavik, while our assistants, Sigurdur Thorarinsson, an Icelander, and Carl Mannerfelt, a Swede, stayed behind. Observations were continued by them throughout the summer, and by the local farmers during the following winter. Thorarinsson returned to the work in the summers of 1937 and 1938, and the farmers carried on up to the end of January 1939.

In this way we obtained the most comprehensive sequence of glaciological observations from the regions of the northernmost Atlantic: eighty-three

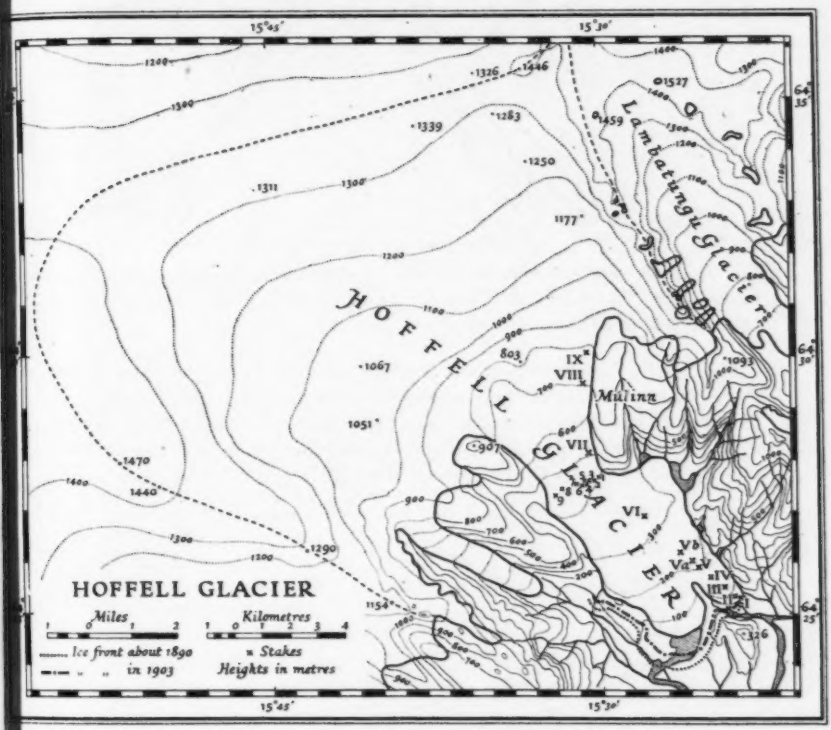


Figure 6

complete series of accumulation and ablation observations taken in altitudes from 100 to 1500 metres above sea-level.

In 1935–36 the accumulation on the south side of the glacier was 2770 millimetres of water, in the centre 2550 millimetres, and on the north, the leeward side, only 1700 millimetres. This distribution of accumulation is approximately equivalent to the precipitation. The snow falls wet and heavy, and therefore wind drifting is not of great importance. On the south side the stratification is very marked as a result of the variable cyclonic weather. On the north side the snow and firn are more homogeneous.

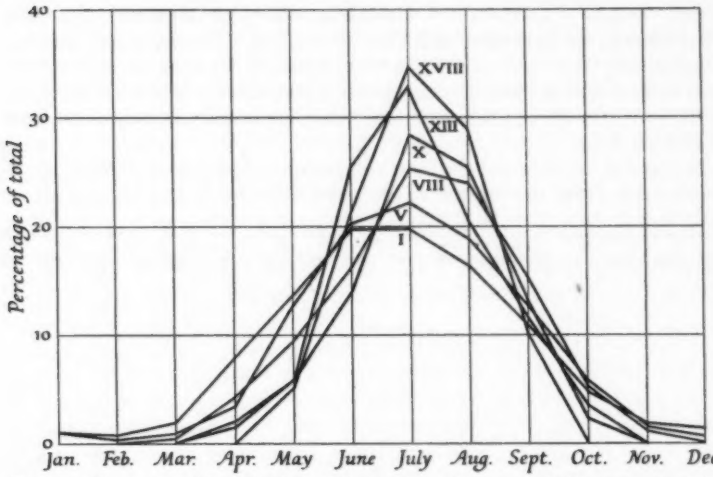


Fig. 7. Mean monthly ablation values as percentages of the annual value, 1936–38: I at 60 m., V at 185 m., VIII at 715 m., X at 1025 m., XIII at 1115 m., and XVIII at 1345 m. above sea level

The relative distribution of the ablation per unit area at different heights above sea-level during the year is shown in Fig. 7. At the lower levels, from 50 to 200 metres, ablation continues all the year round. The summer months account for about 55 per cent. of the total, the winter months for 12 per cent. The higher the altitude the greater the concentration of ablation in the

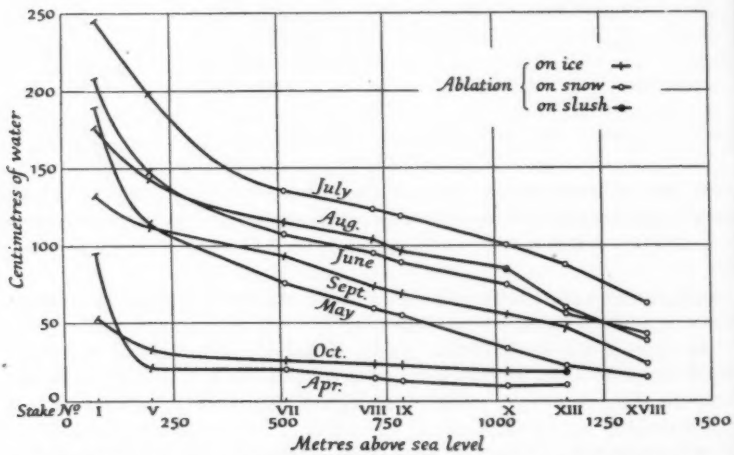
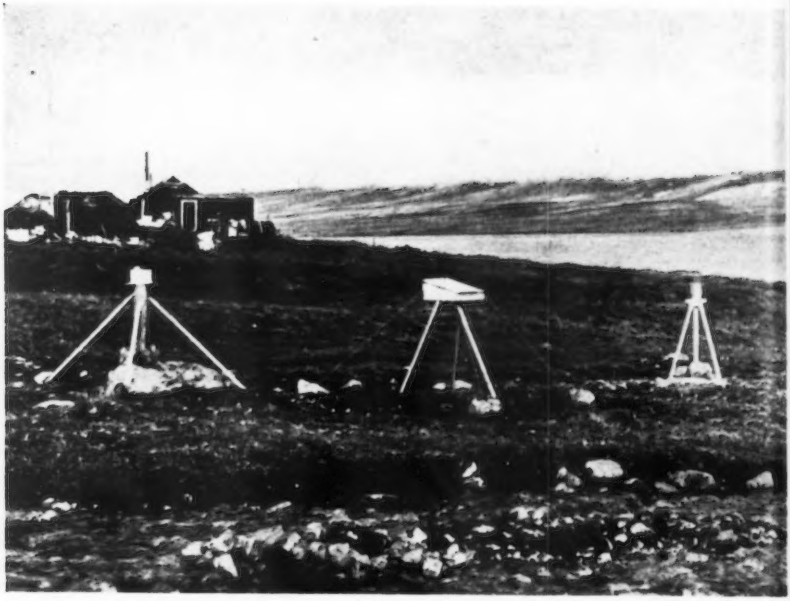


Fig. 8. Ablation in cm. of water per unit area in relation to altitude in each month, April–October 1936

4. Fröya glacier on Clavering Island



5. Revet, the Norwegian trapper station, on the west of Clavering Island

6. Terminal moraines of the Fröya glacier, 1939

summer months. At the firn line, about 1100 metres, the summer ablation reaches 78 per cent. of the total.

Ablation in centimetres of water per unit area in relation to altitude in the different months of 1936 is given in Fig. 8. The altitudes of greatest importance are from 950 to 1300 metres, for although the ablation per unit area is only a fraction of what it is on the glacier tongue, the areas ice-covered are very much larger.

The Table gives the numerical values of the regime or budget of Hoffellsjökull. In the first year, 1935–36, there was a deficit of 364 million cubic metres of water, in the second a surplus of 191 million cubic metres, and in the third year a deficit of 111 million cubic metres. In the regime diagrams, Fig. 9, these facts are represented graphically.

Table showing regime of Hoffell glacier

Ablation area		1935–36			1936–37			1938–39		
m. above sea level	*area in sq. km.*	*acc.*	*abl.*	*diff.*	*acc.*	*abl.*	*diff.*	*acc.*	*abl.*	*diff.*
		(*in millions of cubic metres of water*)								
0–1200	163·2	260	729	−469						
0–1000	75·6				90	348	−258			
0–1100	114·3							146	449	−303
1200–1500	148·7	383	278	105						
1000–1500	236·4				705	256	449			
1100–1500	197·5							413	221	192
Total for glacier										
0–1500	312·0	643	1007	−364	795	604	191	559	670	−111
Total regime			1650			1399			1229	

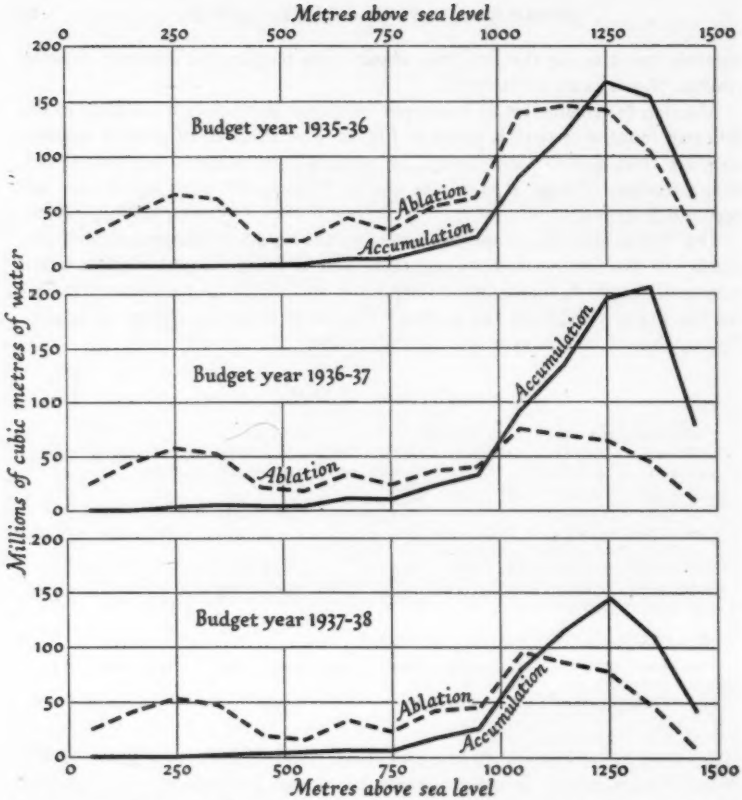
As on the Norwegian, North-East Land, and Spitsbergen glaciers, the balance was negative; in other words, the annual loss was greater than the gain. The margin of Hoffellsjökull as well as that of Vatnajökull was therefore receding and growing thinner. The recent climatic improvement was apparent also in Iceland.

Perhaps the most important of the general conclusions from our work on Vatnajökull is that temperature variations are of more importance to the life of a glacier than variations in precipitation. Also, that the ablation mainly depends on convection or heat brought by the winds from the surrounding warm sea; radiation proved to be of less significance.

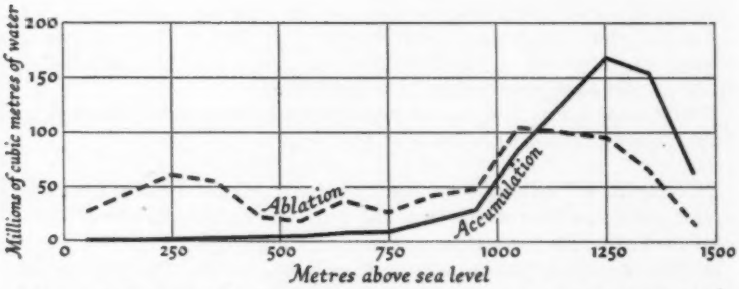
Thorarinsson has made a detailed investigation of the marginal fluctuations of the Vatnajökull outlet glaciers (Fig. 10).

To complete my investigations round the northernmost Atlantic I decided to visit north-east Greenland. Here the extremely continental climate contrasts markedly with the maritime climate of Vatnajökull.

On this expedition I was accompanied by Kaare Rodahl, who read a paper to this Society on his wintering in Greenland (*Geogr. J.* 102 (1943) 97). We left Ålesund in the *Polarbjörn* on 15 July 1939 and, following the Norwegian coast in brilliant sunshine, sailed past Bear Island to King's Bay in Spitsbergen. From there we followed the margin of the drift ice. An attempt to



Total accumulation and ablation in every 100 m. above sea level in each budget year 1935–38



Average total accumulation and ablation in every 100 m. above sea level for the three budget years 1935–38

Fig. 9. Regime diagrams of Hoffell glacier

force our way through in lat. 76° N. failed, but we reached the coast on July 27 in lat. 74° N. where, as is usual, the ice-floes were sparse and easily penetrated. A few days later our equipment was unloaded on the north side of Clavering Island, and we began our work on the Fröya glacier (Plate 4).

As a result of the arctic continental climate there is little snow in the winter, and bright sunshine in the summer. The island is very dry. The ground is bare and sterile, showing the structure of the rocks clearly. The play of colours is more magnificent even than in Spitsbergen: deep blues, pinks, and yellows alternate with the blacks of the basalt beds, crowned with snow.

The country has passed through the same geological-geographical development as have Norway and Spitsbergen. The long arm of the Caledonian mountain chain reaches also across this part of the northernmost Atlantic region. The crystalline schists of Clavering Island are much split by fissures

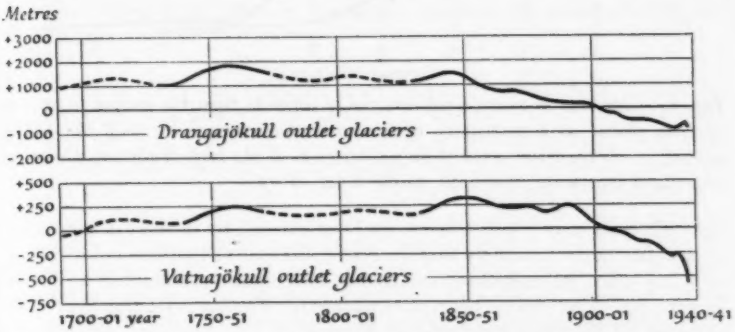


Fig. 10. Linear fluctuations of the Vatnajökull and Drangajökull outlet glaciers

and other zones of weakness, and consequently the rocks are denuded with a rapidity which is difficult to imagine. There is an incessant rattle and thunder from blocks and stones crashing down the precipices, chocolate-brown rivers foam, and in the clear translucent air one can almost see the glaciers excavating their beds in the rock.

The incoming radiation is considerable; but so is the out-going radiation, especially from areas in the shade. Our investigations showed that the Fröya glacier is of the sub-polar type, and almost dead. In the latter part of the summer ablation depends more on convection than on radiation. The curve indicating the decrease of ablation with increasing altitude differs from those of all the other glaciers investigated round the northernmost Atlantic, but resembles that of the Greenland inland ice (Fig. 11).

In front of the little Fröya glacier there is a magnificent amphitheatre of terminal moraines, some of which are 80 metres in height (Fig. 12 and Plate 6). The ground between the terminal moraine and the present margin of the glacier is bare of any vegetation and it cannot be very long since the glacier extended to this moraine, which also marks its maximum extent. As the terminal moraine runs into lateral ones, and higher up on the rocks into a

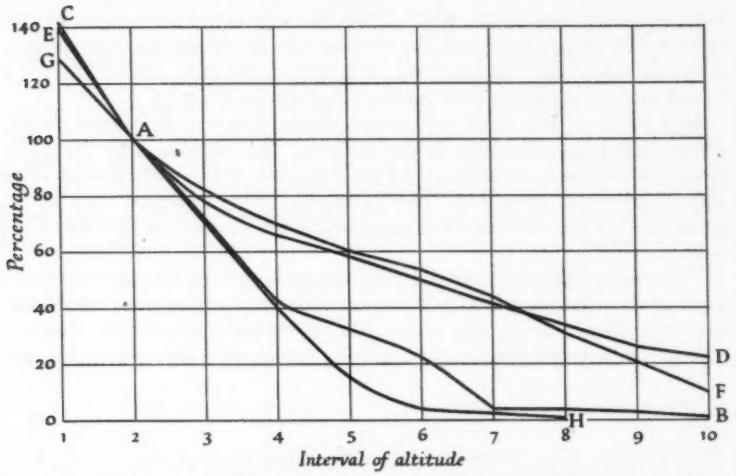


Fig. 11. Ablation in every tenth interval of altitude from the margin to the top of each glacier as a percentage of the value for interval 2: A–B the Frōya glacier; C–D the Fourteenth of July glacier; E–F the Hoffell glacier; G–H the Greenland inland ice, west side, at about lat. N 71°

light-coloured strip which has not yet been covered by lichens, it is possible to calculate fairly accurately that the glacier has lost 118 million cubic metres of water since its maximum extension. This figure corresponds to about 17 per cent. of its volume per square kilometre. The same relative figure was obtained for the Styggedal glacier in Norway.

In the latter half of August we had to leave Clavering Island, as the local fjords begin to freeze early in September. Kaare Rodahl, my Norwegian

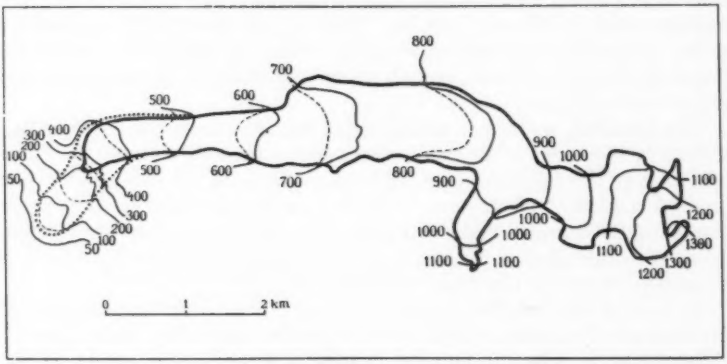


Fig. 12. Frōya glacier in 1939 (thick line) with contours at every 100 m. above sea level (thin lines); maximum extent of the glacier (heavy dotted line) with corresponding contours up to 800 m. (thin broken lines)

assistant, remained with the trappers and continued the observations on the Fröya glacier until the following summer.

Like the Fröya glacier, all the other glaciers in north-east Greenland have terminal moraines marking their maximum extension in post-glacial times. There is reason to presume that in Greenland, as in Norway and Iceland, this maximum extension occurred in the latter half of the eighteenth and beginning of the nineteenth centuries. In north-east Greenland, as elsewhere round the northernmost Atlantic, a post-glacial warm period occurred, during which time the local glaciers disappeared completely or became much reduced in size. The outlet glaciers of the inland ice receded considerably, and the peripheral parts of the inland ice itself grew thinner. After this post-glacial warm period glaciation again increased and, after alternating advance and regression, culminated in the maximum extension of the eighteenth and nineteenth centuries. This was followed by a slow regression, which was interrupted by minor advances, but has increased rapidly during the last decades. The present extensive regression is due to the recent climatic improvement.

Apart from the proofs of climatic improvement given by these investigations, the following facts may also be mentioned. The experiences of the Russian scientists along the North-East Passage are especially noteworthy. In 1930 the Leningrad Arctic Institute was established, and in 1933 became responsible for the scientific work of the Central Northern Sea Route Administration in Moscow. Throughout the 1939 war the Arctic Institute has maintained seventy-seven scientific stations in the Russian sector of the Arctic. The regular air surveys of the extent of the drift-ice, which are carried out during the summer months, have shown that between 1924 and 1942 the drift-ice was reduced by about 1 million square kilometres. The average thickness of the sea-ice in the Polar Sea has diminished from 365 centimetres at the time of the Nansen *Fram* expedition of 1893–95, to the 218 centimetres found by the ice-breaker *Sedov*, which in 1937–40 drifted along a route similar to that followed by the *Fram*. Two fossil-ice islands in the Laptev Sea have completely melted in recent years, leaving only submarine banks. And finally, the temperature has increased in the so-called Atlantic waters of the Polar Sea as well as in the Kara Sea.

While here in London I have heard of the reconnaissance flights of the British Coastal Command between 1942 and 1944. These flights to the Kara Sea and areas east and north of Novaya Zemlya were to some extent complementary to those of the Soviet expeditions. They made it possible to map the limits of the ice edge between Denmark Strait and Novaya Zemlya at intervals of two or three weeks. Further flights to north-east Greenland and to the north of Spitsbergen gave valuable information on the condition of the pack-ice in the hitherto unvisited sector between Greenland and Spitsbergen. These investigations provide the first consistent and detailed study of sea-ice in the North Atlantic and Barents Sea, and I would like to draw your attention to the really epic achievement which they make in the history of polar research.

On the basis of the known extension of the drift-ice it is possible to calculate the general distribution of atmospheric pressure. The direction of the

ice-drift is parallel to the isobars, and the speed of the ice-drift is inversely proportional to the distances between the isobars.

The Arctic fauna has followed the climatic change, and both fishes and fowl are now found much farther north than formerly. The southern limit of permanently frozen ground in Asia has moved many kilometres farther north, and the Spitsbergen period of navigation has lengthened considerably. From 1909 to 1912 it lasted ninety-five days, but in 1930–38 it had increased to one hundred and seventy-five days, and in 1939 to as many as two hundred and three days (from April 29 to November 17). This part of the Arctic may, without exaggeration, be said to have experienced a climatic revolution.

The character of this recent climatic change is best described in Hesselberg-Birkeland's work on the secular variation of the climate in Norway and Spitsbergen. It is most apparent in the increased temperatures during winter, spring, and autumn, an increase which becomes greater towards the north. During this time precipitation has increased only slightly.

An investigation of the meteorological causes of this climatic change, carried out by Eriksson, has led to the following conclusions: a general intensification of the atmospheric pressure gradient has occurred, resulting in increased supplies of warm air to the regions round the northernmost part of the Atlantic. The low-pressure area in the North Atlantic has moved abnormally far north, thus changing the direction of the atmospheric pressure gradient so as to increase the flow of warm air to the Arctic regions.

These facts are in full agreement with those of the glaciological investigations already mentioned. The most important cause of the reduction in ice area is the negative regime created by the great ablation, which is due to the increased transfer of heat through the atmosphere. In regions where radiation is decisive no increase of ablation has been found. This is also indirectly shown by the fact that, if the central regions of the Greenland ice had shown much shrinkage, the eustatic rise of the oceans would have been greater than it has been.

The glaciological investigations of the last twenty years, as well as the accompanying climatic and meteorological analyses, seem to give a satisfactory explanation of some important geographical changes in the northern regions. As long as similar investigations are lacking for other parts of the world it is not possible to form an opinion as to what extent the results obtained can be applied outside the Arctic regions. In low latitudes and at high altitudes radiation certainly plays a far more important role than it does in the Arctic.

The problems involved however are of such general value, not only for research on present glaciers, but also on those of the Ice Age, that it is most desirable that they should be studied in other parts of the world. In the first place more work could be done in the Alps, although glacial investigation has been carried on there to a greater extent than in many other regions. It would be of great value if some glaciers in the Himalaya could be examined, and a series of well-chosen districts along the American Cordillera from Alaska in the north via the sub-tropical and tropical regions to Tierra del Fuego in the extreme south would be of special interest. Naturally much remains to be

done in the inner Arctic. However excellent the results of the Wegener expedition to central Greenland in 1930–31, the meteorological factors governing the regime of the inland ice are still unknown. With the present advances in aviation it should not be difficult to establish and to maintain stations on the ice-cap.

But the Antarctic should stand first on the list. Although later expeditions, particularly Byrd's last one, have given fine results, this largest mass of ice offers so much to study of fundamental importance for the "conditions of life" of glaciers in general that an expedition with an all-round glaciological programme would be of the greatest importance. To carry out an expedition on such a scale international cooperation would be imperative. I wish to express the hope that my country may have the privilege of cooperating with England and my second motherland, Norway, in contributing to continued research work in the polar regions, which undoubtedly occupy a key position for the solution of many problems of universal significance.

DISCUSSION

Before the paper the PRESIDENT (the Rt. Hon. LORD RENNELL OF RODD) said: We have the pleasure of having Professor Ahlmann with us this afternoon to read a paper which we had hoped to have from him last session. But before hostilities came to an end it was difficult to arrange for his transport. It was however a pleasure postponed. Professor Ahlmann is known to a great many of you. He is a recipient of the Patron's Medal of the Society, which was awarded to him in 1939 for his work on glaciology. I do not think I need give him any further introduction.

Professor Ahlmann then read his paper printed above, and a discussion followed.

The PRESIDENT: We have had the advantage of hearing Professor Ahlmann, and to a layman like myself in these matters it would be impossible to contribute usefully to the discussion.

We have among our distinguished guests this afternoon General Fedorov of the Russian Army, better known to some of you perhaps as Dr. Fedorov, the Russian explorer. He is not only a well-known scientist but now for his military achievements also a Hero of the Soviet Union. I am glad to hear that he is shortly resuming his scientific work, and I hope it will take him to those parts to which Professor Ahlmann has referred, so carrying on that international research to which the lecturer has alluded. If before he returns General Fedorov would be good enough to let us have his views on the problems raised by Professor Ahlmann, in particular about the retreat of the glaciers and pack-ice, and the northward extension of vegetation, we shall be very glad to hear what he has to say.

Lieutenant-General EVGENI FEDEROV: I am very glad to be here in the geographical centre of Great Britain, and first of all I want to convey from my colleagues in Soviet Russia our cordial greetings. I have been very pleased to hear the lecture by Professor Ahlmann and I agree with the conclusions he has reached. I can only add that there must be some warming influence in the Arctic due to the circulation of heat which causes the recession of the glaciers. Heat is being transported in some way through the atmosphere from the lower to the higher altitudes during the last decades.

I should like now, Mr. President, with your permission, to present these two books for the library of the Society. [The books presented were 'On the drifting

ice: a short description of the life of the North Pole Scientific Expedition,' by E. Fedorov, 1939, and 'Scientific work of our Polar expedition,' by E. Fedorov, 1939.]

The PRESIDENT: You will wish me to thank General Federov not only for his interesting comment on Professor Ahlmann's lecture but especially for having presented these two volumes to us. We are extremely grateful to him.

In the course of his lecture Professor Ahlmann referred to the work of an expedition led by Commander Glen. I will ask Commander Glen if he will contribute to this discussion.

Commander A. R. GLEN: I should like first to congratulate Professor Ahlmann on an extremely interesting paper. The work which Professor Ahlmann started in the Arctic on glaciometry was the inspiration of that which was carried out on a very much smaller scale by a number of British expeditions between the two European wars: the Oxford Expedition of 1935–36 and the Oxford expeditions to Greenland. All these benefited very largely in the preparation of their scientific programme and in the assessment of their scientific results from the great sympathy and kindness of Professor Ahlmann.

I remember visiting Spitsbergen in 1934 while preparing the 1935–36 expedition and finding Professor Ahlmann in King's Bay, Spitsbergen. He had just carried out thirty-six or forty-eight hours work non-stop on the Fourteenth July Glacier, and was having a well-earned rest in the ship in King's Bay. But quite ruthlessly I woke him up, and with a very clear head and extraordinary keenness he advised us on our work. Professor Ahlmann's kindness on that occasion I cannot overestimate. It has been the inspiration of all the British expeditions in recent years.

Dr. N. E. ODELL: It has been a great pleasure to listen to my old friend Professor Ahlmann, who for many years has given much stimulus to my own work. Our Arctic expeditions are often carried out in somewhat of a hustle, and there is little opportunity for detailed work in the short time we have to spend in the districts visited. Professor Ahlmann has taken the trouble to get down to quantitative observations in detail and it is these which make his work of such very great value. In 1935, when he lectured to the Society on "Physics of glaciers," Doctor Sandford remarked, in the discussion that followed, that Professor Ahlmann was one of those who was engaged in making glaciology an exact and precise science. I also admire him for the work he has done chiefly as an international glaciological liaison officer; in collating climatic and glacial observations made in various parts of the world, and thus extending the scope of those which he has already made himself.

He has carried on his work with extraordinary industry, and his work in Greenland and around the Norwegian sea generally is perhaps the basis of a new era in our understanding of meteorological processes, and, of course, in weather forecasting. I hope there will be increased cooperation between us on this side of the Atlantic and with those on the other side, more particularly with observers of the United States Geological Survey under the leadership of my friend Mr. François E. Matthes, who is, amongst other things, chairman of the Committee on Glaciers of the American Geophysical Union. It has given me great pleasure to listen to Professor Ahlmann, and I shall look forward to studying his paper in print.

Mr. GERALD SELIGMAN: I feel that I am standing here under false pretences. I do not feel qualified to touch on a subject about which Professor Ahlmann has spoken with greater authority than any other glaciologist—I think I can safely say—in the world. But I should very much like to add my tribute to Commander Glen's to the great kindness that glaciologists receive from Professor

Ahlmann whenever they undertake research work of any kind. I have myself received help of very great importance from Professor Ahlmann.

I would also like to take this opportunity of welcoming him here in London, especially as I think this must be one of the first meetings here at which an international communication has been received. After all, we cannot build upon true foundations unless we have the opportunity of knowing what other countries are doing, what discoveries they have made, and what are their thoughts to-day.

Dr. M. F. PERUTZ: I can offer little comment on Professor Ahlmann's interesting lecture, as it dealt mostly with a branch of glaciology which is beyond the scope of our own work on the Jungfraujoch. Professor Ahlmann's researches have been outstanding for his experimental approach to all problems of glacier research; he set us an example by the accuracy of his observations and by his avoidance of speculative conclusions. There is a striking contrast however between the relatively comfortable pursuit of experimental glaciology on the Jungfraujoch, where all food and equipment is delivered by railway each day and additional apparatus could be ordered from the nearest town, and the exacting conditions under which Professor Ahlmann obtained his remarkable results. Now that he has demonstrated the feasibility of such work, it is to be hoped that it will be extended also to other regions such as the Himalayas and the Antarctic Continent.

Mr. GORDON MANLEY (President of the Royal Meteorological Society): I should like to take this opportunity of expressing the keen appreciation of the members of a kindred society for the splendid work which Professor Ahlmann has initiated and accomplished in the past twenty-five years. His results and those of his colleagues are of the greatest climatological significance. In former papers Professor Ahlmann mentioned the semi-permanent snow-beds of Scotland; he will no doubt be interested to hear that they too have reflected the climatic changes shown by the Scandinavian glaciers inasmuch as it is recorded that they melted away completely on more than one occasion during the "warm 1930's." I can assure him that some of us are greatly intrigued by these problems and that the war has not entirely stopped our efforts. Perhaps he and his Swedish colleagues will be interested to hear that in a study of one hundred and ninety-three years of Lancashire temperature records, which I hope will soon be published, the trends of the monthly mean temperatures since 1800 corroborate to a remarkable degree those which have been shown to have occurred in Norway. It certainly appears that these trends, however caused, go far to explain the vicissitudes of the Scandinavian and Icelandic glaciers.

The PRESIDENT: The point that has impressed itself most on my mind in the discussion on the paper has been the phenomenal change that has taken place in the last fifteen years. I should like to ask Professor Ahlmann whether what he describes almost as a cataclysmic change in its effect on glaciers is one which is likely to continue or whether it is only a phase which in due time will be reversed. For example, in research over the records for the last two hundred years is there any parallel phase to be found, or are the happenings to which Professor Ahlmann has directed our attention something quite new?

Professor AHLMANN: The investigations in Norway and Spitsbergen have shown that the climatological improvement began very slowly in the middle part of the nineteenth century and has gone on the whole time, but that in the last decades it has increased very rapidly, especially north of 65° N. We cannot as yet look into the future.

The PRESIDENT: It remains only to thank Professor Ahlmann for his paper and again to express our welcome to him. I hope this is the precursor of other

and similar papers. Incidentally may I say that we look forward to hearing the result of the Russian research which has been going on for the last ten years. I hope that General Fedorov will take that message back to the Academy of Sciences and to the scientific workers of the Soviet Union, and will undertake either to come himself or to send some one else to tell us of those results about which we shall be so grateful to hear.

Professor Ahlmann then showed a short colour film taken on his expedition.

ANCIENT ARABIA: EXPLORATIONS IN HASA, 1940–41

P. B. CORNWALL

ON A MAP of Saudi Arabia the province of Hasa appears as a long and rather narrow slice of territory running from Qatar peninsula north-north-west to the neutral territory which lies just below the little shaikhdom of Kuwait. The Persian Gulf borders Hasa on the east, while to the west stretch the rolling uplands of Najd—primitive heartland of Arabia. Until very recently, when the presence in Eastern Arabia of immense oil deposits became known, Hasa was a land almost entirely overlooked by the western world. Though historical records of this area are meagre and fragmentary they suffice nevertheless to give us glimpses of a very ancient civilization.

Beginning as early as *c.* 2500 B.C., the Sumerians appear to have imported highly prized dates from Hasa by way of Bahrein Island; and in the days of Sargon (722–705 B.C.), greatest of the Assyrian monarchs, Hasa and Bahrein formed a single kingdom, as indeed may also have been the case in earlier centuries. From Greek and Roman geographers we know that the Arabian coast of the Persian Gulf held important trading centres, and that through them passed much traffic between India and the Mediterranean lands. A Sassanian king sailed across the Gulf early in the fourth century A.D. and conquered the entire Hasa littoral; but the Iranians were forced to yield it back into Arabian hands when Islam began its triumphant march in the seventh century of our era. We also possess evidence that in early medieval times the population of Hasa included many Nestorian Christians, as well as Jews and Iranians. Later, it became the stronghold of the fanatical Carmathians, who actually seized and carried away from Mecca the famous "black stone" which they kept in their possession for some twenty years.

Hasa has therefore much to offer the explorer and the archaeologist. Yet in the past remarkably little scientific work has been done in the province. There are a number of reasons for this. In the first place, Arabian exploration has never been an easy matter. Then, too, in 1871 the Ottoman Turks established garrisons in Hasa and asserted a nominal authority, and for about forty years discouraged every attempt by European explorers to enter the country. But the Turks' position there was always exceedingly precarious, and just before the First World War they were attacked and quickly driven out by Arab bands under Ibn Saud, the present king.

In 1863 William Palgrave passed through the province. So did H. St. J. B. Philby in 1917 and later. Captain (now Colonel) R. E. Cheesman who travelled from Hofuf [1] to Jabrin oasis in 1923, was the first European to visit that remote, almost legendary settlement; later he went also to Salwa. Captain W. H. I. Shakespear and Captain Leachman also traversed parts of Hasa. Nevertheless large portions of the province remained to be explored and described.

In the spring of 1939 I laid plans for carrying out a preliminary archaeological survey of North-eastern Arabia and Bahrein Island. The project immediately received helpful and enthusiastic support from Professor J. L. Myres, Professor S. A. B. Mercer, the late Sir Arnold Wilson, Sir Aurel Stein, Dr. Oliver Gurney (now Shillito Reader in Assyriology in Oxford University), and many others. Unfortunately, the outbreak of war in the following September intervened just as the small expedition was about to get under way, and for a time it appeared that not until after the war could our plans be carried out. But just one year later, in September 1940, it was suddenly decided that in spite of disturbed conditions in the Middle East I should go alone by air to Arabia to carry out as much of the original plan as might still be possible.

I went by way of the Pacific. Leaving San Francisco on 5 October 1940, I travelled in a Pan-American Clipper, stopping at Wake, Midway, and other sandy, tranquil islands that were later to be the scene of fierce fighting and much bloodshed. From Hong Kong I went to Calcutta by way of Chungking and Rangoon, reaching Bahrein only a few days after that little island had been bombed, unexpectedly and ineffectually, by the Italians. This air-raid, together with the war-time atmosphere, made the undertaking of archaeological work on Bahrein abnormally difficult. But in the Adviser to the Bahrein Government, C. Dalrymple Belgrave, C.B.E., I found a friend and ally. Thanks to him I was able to begin steady work on the Bahrein tumuli fields. Later, I was also given the opportunity to cross to Hasa and to spend two interesting months there.

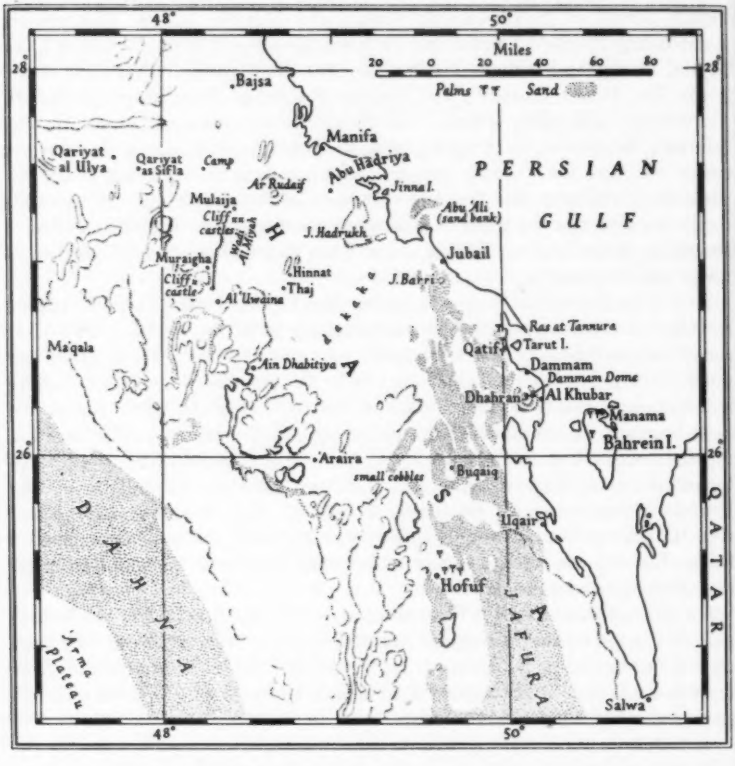
On the Arabian mainland I was the guest of the California-Arabian Standard Oil Company, and through its generosity most of my exploring trips were carried out in two of the Company's "pick-ups." Apart from a pair of Arab drivers, I was usually accompanied on these trips by an American oil man and an armed soldier of the Saudi forces.

It seemed best to commence the survey by working northward from 'Uqair. There in 1921 Cheesman found a ruin-field which he suggested was the site of ancient Gerra, the exact location of which had long been a matter of controversy among geographers. Gerra was for many centuries a famous emporium of the ancient Middle East, and the literature on the history and location of the city is both varied and interesting. Strabo reports that it was formerly a Chaldaean colony which had a flourishing trade with Babylon. As a caravan station however Gerra must already have been of great antiquity,

[1] For a description of the Hofuf district see R. E. Cheesman's admirable book 'In Unknown Arabia,' 1928. See also J. B. Mackie, "Hasa: an Arabian oasis" (*Geogr. J.* 63 (1924) 189–207).

and it was perhaps during early Neo-Babylonian times that it began to increase markedly in population and affluence. By the time of Eratosthenes (*c.* 276–194 B.C.) Gerra had become a very important centre of trade, receiving spices and other goods from South Arabia, India, and Africa, and forwarding them to Babylon or Seleucia.

Agatharcides, who wrote in the second century B.C., states that Gerra had become the chief emporium on the east side of Arabia, and that its inhabitants



were said to rival in wealth the Sabaeans, to whose country their caravans repaired. Another vital route which passed through the city carried trade between India and the Mediterranean, utilizing the desert road which led from Gerra through Hail and Taima.

We set out from Dammam Dome early in December, our two motor cars equipped with wide, low-pressure tyres. Even so, our progress was cautious and difficult, for in the preceding week there had been more than four inches of rainfall: more than had been recorded at any one time in North-eastern Arabia during a period of about twenty years. Finding it impossible to drive over the soggy *sabkha* area along the coast, we had to proceed southward through the

North Jafura dunes, correcting our course from time to time by compass readings. The dunes were sometimes 100 feet high, with a very steep drop on the southern face, and repeatedly we had either to turn aside or to back down, in order to find a route suitable for the cars (Plate 1).

Eventually we swung south-east towards the coast. The dunes decreased in size, and here and there we passed a few stunted, wind-beaten *ithil*, or tamarisks, and small patches of gypsum. About 2 miles due west of 'Uqair our cars came into a depression [1] containing several groves of palm trees, stunted, and in most cases with only the tops showing above the sand. Between these palms and the extensive 'Uqair ruin-field to the north-east there now rolls an undulating sea of dunes; but a study of the locality suggested that at one time part of this area was quite free of sand, and that a large date-garden skirted the western side of the ancient settlement. At Qatif, near Dammam Dome, great dunes are at present encroaching steadily on the city's date gardens, which some day may nearly vanish like those of 'Uqair (Plate 11).

The destruction caused in North-eastern Arabia by such encroachment will be illustrated later in more detail. It is clear that during the past two thousand years the sand has greatly lessened the cultivable area of the Hasa littoral. To-day the only large fertile districts are at Qatif and Hofuf; but the Arabs speak with regret of the "old times" when, according to their legends, a more or less continuous palm-garden extended all the way from Qatif to Hofuf. While this must certainly be an exaggeration, in the first millennium B.C. Qatif probably had three times the date-garden area it now has, and 'Uqair must also have possessed a sizable tract of fruit-bearing palms.

The ruin-field proper at 'Uqair measures about 2 miles by 1½ mile, with the long axis pointing north-north-west. Near the lower end is a fortified well and the locality known as Abu Zahmul. The ruin-field, with its mounds and the remains of stone foundations, is littered with sherds and pieces of coloured glass. There are quite clear indications of two distinct cities. The more extensive is marked by foundation walls of medium-sized, well-shaped, mortared limestone blocks; the other was built less solidly upon mud-joined slabs of coral rock. The stone foundations of the former seem to outline streets and quays, and lie mainly to the north-west. The ruins of the latter type partially cover these, and also extend much farther out towards the present coast-line.

I think it can be assumed that this eastward extension was carried out because of a recession of the Gulf waters, for during historic times there has been a drop in the water-level of from 5 to 10 feet. The present-day town of 'Uqair is built even farther out in the Gulf. It stands in fact on a low spit of sand that probably did not exist at the time when the earlier of the ruined cities was built. And it is important to note that the Persian Gulf is so shallow that even a small drop in sea-level has a substantial effect on the shore-line.

A very large ruined *qasr* of Iranian style is situated half-way between the ruin-field and the present shore-line; and other, smaller *qusur*, are to the west and north of the site. These are pentagonal in shape.

From the extent and nature of the ruins it could clearly be seen that here

[1] Said to be called As Suwwad, *cf.* Mackie, *Geogr. J.*, *loc. cit.*

had once stood a city which by Arabian standards was large and important; and from the nature and diversity of the pottery and glass it was equally evident that the settlement had existed in no cultural backwater, but on international trade routes. The stone foundation-walls of the earlier city are utterly unlike anything I found elsewhere in Hasa. They have a decidedly un-Arab appearance and are more like classical Greek foundations. As for the sherds on the surface, many of them are of blue or green glaze, medieval and Iranian in type; but I found also some pottery that appeared to be of Graeco-Roman date. Excavation should turn up much more, although it is probable that a good deal of the earlier debris has been washed into the mud flats. The city stands on a slope, and instead of accumulating in layers a great amount of material has been swept downhill, thereby gradually filling up part of the old harbour.

I succeeded in making a rough map of the area, but an accurate plan of the ruins would be possible only after extensive and probably unrewarding excavation. Nearly everything of value appears to have been removed long ago, and apart from the pottery and glass I could find little except pieces of stone that evidently had been shaped for use as lintels. Pliny the Elder states that Gerra was "five miles in circumference." This would be no exaggeration, if one takes into account the likelihood that a considerable portion of the older city now lies buried beneath the sand.

Later I was able to explore the coast almost continuously from 'Uqair to Jubail, 100 miles north, and nowhere did I find the remains of an early coastal city of any size. It is true that ruins exist at Salwa, south of 'Uqair; and it has been claimed that Gerra was located there. But an objection to this theory is the reported smallness of the site at Salwa. Nor, from what I have heard and read, does the character of the debris there suggest a city of the first few centuries B.C. Even to-day the harbour at 'Uqair is the most convenient and the best-sheltered landing place for goods destined for Hofuf and the interior. Had it not been for the recession of the Gulf waters, and the silting up of channels, modern 'Uqair unquestionably would be of much greater importance than at present, when it comprises merely a Customs House and a few huts. That there is a strong philological resemblance between Gerra and 'Uqair (pronounced Ujair) has already been pointed out by Colonel Cheesman and others.

Then, too, Pliny gives us very valuable information concerning the location of Gerra. He says, "50 miles from the coast, lying in the interior, is the region of Attene, and opposite to Gerra is the island of Tylos, as many miles distant from the shore; it is famous for the vast number of its pearls." Pliny's measurements are in Roman miles, and his statement is a surprisingly accurate description of the relationship which the 'Uqair site bears to Hofuf and Bahrein. The large and fertile oasis of Hofuf is about 47 Roman miles into the interior. It is, in any case, the only really habitable and important inland region in Hasa. In Pliny's time it must have been, as now, a well-populated area. Caravans naturally would have halted there on the long journey from Gerra to the Hadramaut or the Mediterranean. As for Bahrein Island, called Tylos in classical times, its shore-line directly opposite 'Uqair is about 29 Roman miles away. But the principal towns of the island have

always been at the northern end, which is approximately 50 Roman miles from 'Uqair. Bahrein, needless to say, is still "famous for the vast number of its pearls."

In view of these many considerations, it seems reasonable to conclude that Colonel Cheesman's suggestion is correct, and that the early ruins at 'Uqair are indeed those of ancient Gerra.

The city's decline as a seaport seems to have been caused by three things: a drop in the water-level; the silting up of channels; and the increased use of other trade routes, particularly those skirting Arabia by sea. Yet we know from Arab histories that the locality was never completely deserted, and it has continued to be the special port of Hofuf oasis.

It is perhaps worth noting that the practice of agriculture in the 'Uqair area must always have been difficult. The soil is poor and the supply of fresh water almost certainly was quite limited. Since the local water is gypsum-saturated, much of the irrigated ditch area would have been hardened by secondary gypsum, thus throwing a good deal of land out of cultivation.

It is obvious that very little stone was used in the building of Gerra, except for the foundation-walls. The houses must have been made of some perishable building material, and this is precisely what we are told by Graeco-Roman authors. Pliny mentions that the towers of Gerra were "built of square blocks of salt," while Strabo gives an even fuller description: "The soil contains salt and the people live in houses made of salt; and since flakes of salt continually scale off, owing to the scorching heat of the rays of the sun, and fall away, the people frequently sprinkle the houses with water and thus keep the walls firm." No actual salt beds are known to exist in this region, but the *sabkha* areas are very extensive. If the houses of Gerra were built of mud bricks, as seems most likely, then the material must have come from the clay beneath these *sabkhas*. In this clay the percentage of gypsum and crystalline salt is high, and of course the bricks would have been subject to strong chemical changes. Accordingly, I suggest that when Strabo refers to the salt scaling off he is simply describing the effect of efflorescence upon saline mud.

It is approximately 50 miles up the coast to the head of Dauha Dhalum, and between the dunes and the raised shell-beaches lies a wide belt of low marshy land, broken here and there by isolated dunes. In places this *sabkha* area is more than 8 miles in width. There are no towns or forts anywhere along the barren, lonely shore. Sometimes one may meet an Arab hunting with a falcon, but even the Badawin seem to avoid this desolate region. In Ptolemy's map of Arabia Felix this area is shown as belonging to the Gerraei. Sprenger observes that the word *Ger'a* means "a place where nothing grows," and the name is certainly appropriate.

About 16½ miles north-north-west of 'Uqair we came upon an early and extremely interesting habitation site. It lies just east of where the dunes end, and what first attracted my attention was a long, low, peat-like wall, running from east to west. Scattered about were pieces of crude pottery, polished stone implements, and small chips of opal. There were also some beads, part of a copper object (perhaps a knife) and an oblong limestone trough, 13 inches in length. There were indications that the site may once have been

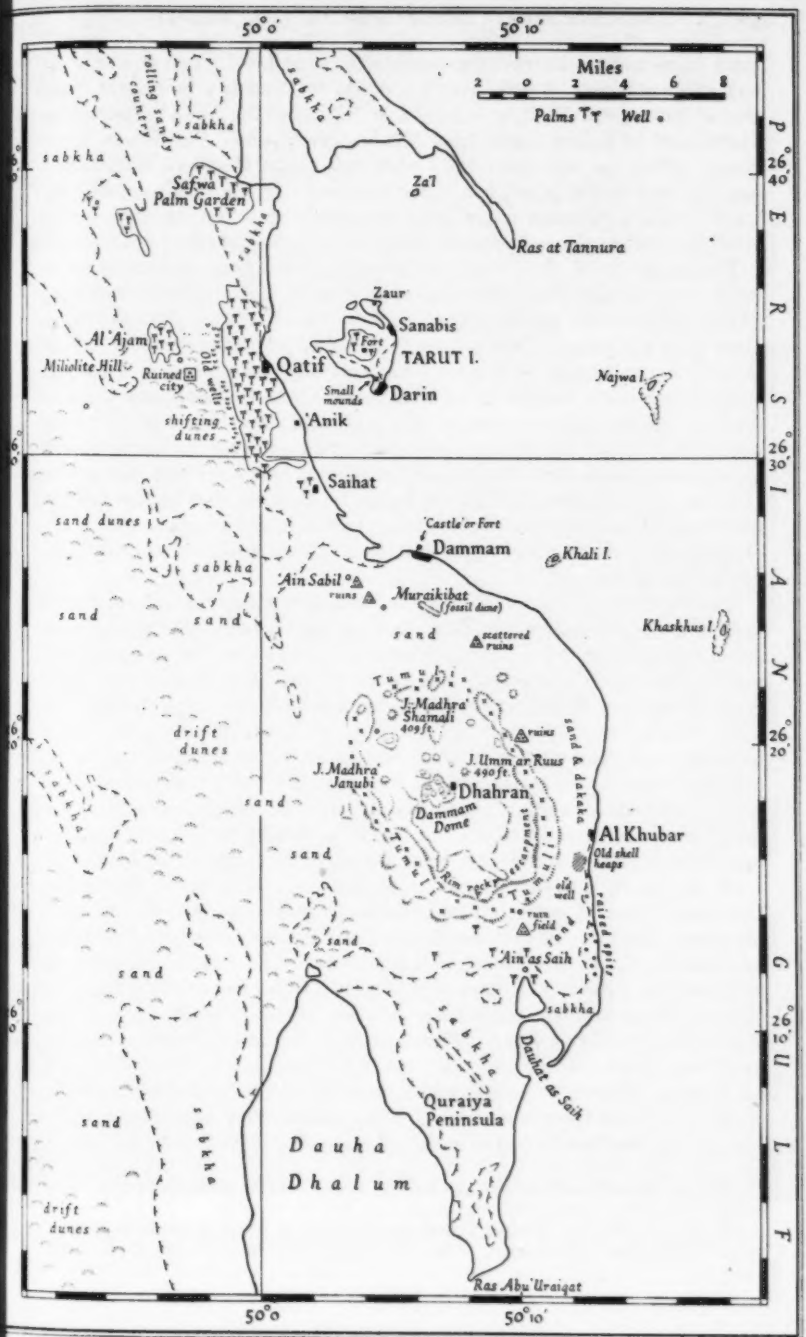
completely surrounded by water, except for a causeway. On the north side of the wall is the bed of a dried-up lake, paved with countless freshwater shells (*Melanoides tuberculata* (Müller)). Their presence, and the size of the lake bed, showed that here there had been a large enough supply of fresh water to satisfy the needs of some early community. The recent rains had almost completely exposed the material, which seemed to be of the Chalcolithic Age. The copper specimen, when analysed, showed 84·72 per cent. copper. The remaining 15·28 per cent. not accounted for was attributed to oxide and a small amount of carbonate caused by oxidation of the copper.

Among the stone pieces on the site were crude objects which may have been picks. There were also implements suitable for pounding and mixing; a porphyry scraper; and a number of small, highly polished, quartzite pebbles, round or oval in shape. Some of the various stone tools were of local chert or dolomite, and there were also present some green chert objects identified as Maastrichtian and probably from the Red Sea region. Most of the pieces however were of igneous or metamorphic rock, and exhibited great variety. Large cobbles of the two latter types could have been picked up in the gravels of the Aruma plateau, about 160 miles west-south-west of this site; but smaller cobbles occur much nearer, some being within 50 or 60 miles. Both types come from the interior granite country and bear witness to the strength and swiftness of the drainage streams of the Pleistocene. Examination of the stones on this site confirms the theory that they were picked up on the surface and then carried by man to the Gulf shores. One point, made of opal, has a prominent solution and cavities on one old surface, but a slight solution and wind polish on the remainder of the specimen. It suggests that the original pebble was long exposed to wind action, subsequently broken in making the implement, and then further exposed, but for a shorter period. The pottery is mostly reddish brown or dull grey in colour, and the bottoms are slightly flattened. Only one piece has a slip: of red on grey.

It is, of course, impossible to speak with any certainty of the date of this site, but it might possibly be as early as the second or third millennium B.C. The climate in North-eastern Arabia must have been more humid when the site was occupied. In spite of the unusually heavy winter rainfall not long before our discovery of it, no water was in the bleached lake-bed; the downpour had merely served to wash away the top sand, leaving the stone pieces bright and clean in the sun.

A little over 1 mile north-west of the lake-bed we came upon a large mound tumulus or burial mound, some 14 feet in height and standing between two small dunes. No traces of any settlement could be found nearby.

By far the most interesting region in Hasa, both geologically and archaeologically, is opposite the northern end of Bahrein Island and centres around Jabal Umm ar Ruus. This jabal forms part of the hilly area occupying the centre of Dammam Dome, a dome mountain in the stage known as maturity. The rim-rock structure forming a great oval around the inner basin is some 25 miles in circumference, and inside this is Eocene strata. The western contact point between the Eocene and the outlying Miocene is about 10 miles west of the coast-line at Al Khubar. Within this rim-rock basin lie


50° 0′
50° 10′
Miles
2 0 2 4 6 8
Palms
Well
26° 40′
26° 30′
26° 20′
PERSIAN GULF
sabkha
rolling sandy country
Safwa Palm Garden
Za'l
Ras at Tannura
Zaur
Sanabis
Fort
TARUT I.
Al 'Ajam
Miliolite Hill
Ruined city
Qatif
Darin
Small mounds
Najwa I.
shifting dunes
'Anik
Saihat
sand dunes
'Castle' or Fort
Dammam
Khali I.
'Ain Sabil
ruins
Muraikibat
(fossil dune)
sand
scattered ruins
Khaskhus I.
J. Madhra' Shamali
409 ft.
ruins
drift dunes
J. Madhra' Janubi
J. Umm ar Ruus
490 ft.
Dhahran
Dammam Dome
escarpment
sand & dakaka
Al Khubar
Old shell heaps
Rim rock
old well
ruin field
raised spits
'Ain as Saih
Dauhat as Saih
Quraiya Peninsula
Dauha Dhalum
Ras Abu 'Uraigat

three important landmarks; the central one being Jabal Umm ar Ruus, 491 feet above sea-level. A little over 3 miles to the west is a prominent cone-shaped butte, Jabal Madhra' al Janubi, or "Shield of the South"; and 3 miles to the north of Janubi stands Jabal Madhra' ash Shamali, the "Shield of the North" (Plate 3). The latter has a wide rock bench about one-third of the way up, and its top is 409 feet above sea-level. On the outer slope of the wavy rim-rock escarpment are many thousands of burial mounds, and a small number are also to be found on the rock bench of Madhra' ash Shamali.

The existence of these fields of tumuli on the north-eastern coast of Arabia is of considerable archaeological importance in that it throws new light on the subject of the Bahrein burial mounds, and in addition gives us further clues as to the extent of the mound-building culture of prehistoric Arabia. Bahrein Island has long been noted for its vast necropolis, and during the past sixty-seven years a number of its mounds have been excavated and studied, for long with inconclusive results. In 1925 the late Dr. Ernest Mackay paid a short visit to Bahrein, during which he carried out a careful excavation of some of the tumuli there. He formed the opinion that the island might have served as a sacred burial ground for bodies brought across from the Arabian mainland. He was however unable to visit Hasa and remained unaware of the existence of tumuli fields at Dammam Dome, although they lie only 20 miles north-west of Bahrein.

Working both on the island and the mainland, I devoted six months to making a new investigation of these early tumuli.[1] I found that the mounds are of two principal types. Firstly, there are small and rather compact rock tumuli (Plate 6). These average about 8 feet in diameter and 4 feet in height, but a few are considerably larger. Many have retained their original shape very well. This is especially so in cases where the sides were constructed of slabs laid horizontally and inclining a little inwards toward the top, thus forming an excellent retaining wall. Some of the rock tumuli present the appearance of crude "pill-boxes," and are much like the mounds which Philby found in South-west Arabia and describes in 'Sheba's Daughters.'[2] Apart from the tumuli in the Dammam Dome area, I discovered a group on Ar Rudaif, a hill located in a desolate region approximately 110 miles north-west of Dammam Dome. A crude, oblong chamber generally occupies the centre of these rock mounds. Sometimes however the tumulus is built of large or medium-sized limestone slabs, piled haphazard and partially covered over with sand and gravel. The outer edge may then be formed of large stones set vertically in the ground. Indeed in some cases all that is left is a circle of big stones, and it seems clear that the inner mass of sand and limestone chip must have been blown and washed away. One of the mounds along the rim-rock has a curious pathway or avenue leading from it. This is formed by two walls, 2½ feet wide and about a foot high. The space between the walls is 3 feet wide and no less than 60 feet in length. Taking the compass-direction of this

[1] For photographs and a brief preliminary report see the author's article, "The tumuli of Bahrein," *Asia*, April 1943.

[2] H. St. J. B. Philby, 'Sheba's Daughters: a record of travel in southern Arabia,' 1939. See also Gerald De Gaury, "A burial ground in Al-Kharj" (*Geogr. J.* 106 (1945) 152–3).

1. Isolated dunes between Dammum Dome and the North Jafura desert: aerial view from 10,000 feet

2. Tumuli field north of 'Ain as Saih: aerial view from 10,000 feet

avenue I found that it faces due north from the mound. No such avenue occurs on Bahrein Island, but both there and on the mainland are a few tumuli with an outer ring of stone and gravel. In a typical case the mound is 13 yards in diameter, and a distance of approximately 5 yards separates it from the encircling wall, which is only a foot high. The purpose of the outer circle was probably to prevent encroachment.

Tumuli of the second type are often much bigger than the rock mounds, and in Hasa they are nearly all grouped closely together in a locality 4 miles north of 'Ain as Saih (Plate 2). One of the biggest mounds there is fully 33 yards in diameter and 13 feet in height (Plate 5). Unfortunately, political conditions prevented my opening any of the tumuli in this 'Ain as Saih group; but in appearance the mounds are practically identical with the Bronze Age tumuli which Mackay and I excavated on Bahrein. In these, each of us found skeletons [1] whose skulls are dolicocephalic, broken and unbroken pottery with rounded bottoms, pieces of ivory and ostrich shell, and bronze weapons.

My discoveries suggest that the culture of the people who built the rock tumuli was either late Chalcolithic or early Bronze Age. There was still, apparently, much use of chert for artifacts. And the fact that the rock tumuli are located on heights and in remote regions indicates that the people must have been hunters and herdsmen rather than settled agriculturalists. The tumuli of the second category however clearly belong to a settled community, and on Bahrein Island they are of the advanced Bronze Age and evidently date from the second millennium B.C. A not unlikely theory is that these Arabian mound-builders came to the shores of the Persian Gulf some time late in the third millennium, or early in the second. Furthermore, there appears to be some ground for believing that they came from South-west Arabia, perhaps forming part of the Semitic migrations which supposedly brought new peoples into Syria, North Arabia, and Mesopotamia.

Desiccation in the interior of Arabia may have been a primary cause of the early mound-builders' migrations. Bahrein Island can be seen quite distinctly from the mainland on clear days, and sooner or later some of these nomads must have ventured out in the Gulf and settled on the island. This step may well have been hastened by contact with Persian Gulf traders, for at that time the Bronze Age culture was well established elsewhere in the Middle East, and by removing to Bahrein these tumuli-builders would have brought themselves into more regular contact with the early trade route between Mesopotamia and the Indus. It is quite possible indeed that at that time there was a small Sumerian colony on Bahrein.

Thus, during the second millennium B.C., there dwelt on Bahrein Island and on the neighbouring mainland a tribe with strongly defined burial customs, bronze weapons, and some skill in handling boats. This straightway raises the question of whether such a people is known to history. Beginning as early as *c.* 2500 B.C., cuneiform records composed in Mesopotamia mention an island called Dilmun or Tilmun. In Sumerian the name was also written, ideographically, Ni-Tukki. This island was located in the Lower, or "Bitter," Sea, as the Persian Gulf was then called, and its identification with Bahrein

[1] I secured a series of nearly complete skeletons, but I have not yet been able to arrange for their proper examination.

Island is quite certain.[1] In classical times the island was known as Tylos. In Assyrian inscriptions of the early first millennium B.C. the kingdom of Dilmun is spoken of as including territory on the Arabian shore, although the ruler of the land "had his abode in the midst of the sea, like a fish," that is, he dwelt on Dilmun Island (Bahrein).

The products recorded as having been imported from Dilmun into early Mesopotamia are dates, copper, bronze, wood, spices, and "odorous plants." It is believed that the Dilmun dates, which were prized beyond all others by the people of the Tigris and Euphrates, may have come largely from Hasa, which still produces dates so fine that they are esteemed in all parts of the Arab world. As for the other products, it is almost certain that the copper came from Oman, and the wood and "odorous plants" from India. In fact, Bahrein Island seems to have been at that time, as it is to-day, the principal commercial station on the sea route between India and Mesopotamia.

There must certainly be a connection between the burial mounds of Bahrein and the tumuli discovered by Philby in Kharj, Aflaj, and in the south-western part of Arabia; and such mounds have also been reported to me from Muwaih, about 143 miles north-east of Mecca. When inner Arabia is better known it may be possible to trace the diffusion and development of this peculiar mound-building culture.

Beginning less than a mile south-west of Al Khubar, and running south, are a number of huge, elongate shell heaps, one being over 100 yards in length. These middens are near habitation sites featuring plain, badly fired, black or red pottery, tubular granite pestles, and stone diving-weights. The shells are *Pinctada margaritifera* Linnaeus var. Persica Jameson. Consequently the sites must be old pearling camps. The medieval Arab geographers mention considerable pearling activity by people dwelling on the coast near Qatif.

A study of the immediate locality revealed that the Gulf water-level was somewhat higher when the shell heaps were formed; and the old shore-line just east of the middens is well defined. Between it and the present shore the *sabkha* area is 380 yards wide, and is raised several feet above the present water-level.

From the prehistorian's point of view, it is of primary importance to discover what role Arabia played in man's development during the Pleistocene period. According to one school of thought, the ancestors of the whites in their more advanced form developed during pluvial periods of the Pleistocene in parts of what is now the arid zone reaching from the Sahara to northern India. Recent explorations in Transjordan have revealed the presence there of palaeoliths, some as early typologically as the Lower Acheulian. In the Hadhramaut the only palaeolithic industry yet found is, I understand, a crude flake industry of Levalloisian type. By far the greater portion of the Arabian land mass remains however *terra incognita* for the prehistorian, and it is thus

[1] See W. P. Albright, *Journal of the American Oriental Society*, (45 (1925) 237 ff.); P. B. Cornwall, "Dilmun: the history of Bahrein island before Cyrus" (Doctoral thesis, Harvard University, 1944), to be published in 1947. I have also summarized the cuneiform and other evidence in an article, "On the location of Dilmun," appearing in the April 1946 issue of the *Bulletin of the American Schools of Oriental Research*.

3. Jabal Madhra' ash Shamali from the north-east; typical sabhka in the foreground

4. View from half way up Jabal Madhra' ash Shamali looking north-east

5. Large tumulus north of 'Ain as Saih

6. Rock tumuli on the bench of Jabal Madhra' ash Shamali

impossible to determine accurately the distribution of palaeolithic industries existing there, or to say in just what manner these industries are connected with those of lands adjoining the peninsula.

Shortly after arriving in Hasa I met an experienced American oil man who had been supervising the construction of tanks on the road which now crosses central Arabia from Riyadh to Muwaih. He told me that he had found "a very large arrowhead," and upon my expressing interest he was kind enough to say he would give it me. When produced it proved, as I had half expected, to be a Lower Palaeolithic hand-axe (Plate 8). Others have been found in Arabia, but none quite like this or so excellently fashioned. It is $7\frac{1}{4}$ inches in length and greenish-grey in colour. Typologically it is Acheulian, and was made from a somewhat altered volcanic rock. The hand-axe was found *in situ* at Dawadami, which is in the very heart of Arabia and about 375 miles from the Persian Gulf. It was turned up when a pit was being made for a tank, and from the colour of the soil clinging to it the finder concluded that it had lain anywhere from 2 to 6 feet beneath the surface.

Before leaving for the Middle East I had examined aerial photographs of various localities in Hasa, and had been struck particularly by the characteristics of Jabal Madhra' ash Shamali, the "Shield of the North" (Plate 3). The wide rock bench extending all the way around this butte makes the site a strong one defensively, and the bench commands a good view of the immediate neighbourhood (Plate 4). Moreover, from the top of the *jabal* it is possible to see the whole surrounding countryside and also Bahrein Island towards the east-south-east.

Such a location naturally would have been ideal for palaeolithic hunters, and I hoped that I would find some trace of them there. It was with a feeling of anticipation, then, that I first climbed the slope to examine the rock bench. I was not without some reward. On the ground between the scattered rock-tumuli gleamed many bright flint artifacts. The fierce winds which scour Hasa had kept the flint pieces from being buried deeply, and now the heavy seasonal rains had exposed many of them and washed them clean.

Eventually I collected a good many points, flakes, scrapers, cores, and rejects from this site. Various techniques are represented, but as the pieces are surface finds the questions they pose are formidable. At present I am inclined to believe that some of the artifacts are comparatively recent, made probably by the earliest mound-builders, but that other pieces were fashioned by men who were indeed in a palaeolithic state of culture. It is significant that, despite careful search, I could not find similar objects on Bahrein Island.

Hasa does not impress one as being a likely place for the discovery of early man's skeletal remains, supposing he lived there. Pleistocene deposits are rare; caves are few in number, and no really large one has been reported. In Pliocene stratum, 90 miles west of Dammam Dome, oil geologists have found some leg bones and teeth from a primitive form of mastodon. A small part of the skull of an early antelope was unearthed in the same locality and stratum.

During the Pleistocene period there must have been very great climatic changes in the peninsula. We have irrefutable evidence that during glacial

epochs in Europe Arabia had a much more humid climate than at present. There is a well-developed climatic (fossil) drainage in the interior, such as the Wadi al Batin and Wadi ar Rima. Between the pluvial periods the land appears to have been arid, but not necessarily to the present extent. In 1940 the rainfall at Dammam Dome was 4¼ inches, but there is much yearly and local variation. The range in North-eastern Arabia is between ½ inch and 6 inches yearly. Since the last glaciation there seems to have been a steady process of desiccation, apparently heightening not long before 2000 B.C. The wind has stripped off hundreds of cubic miles of material in Hasa alone, carrying it far out over the Indian Ocean.

About 2 miles inland and south from the gulf-side town of Dammam is a fossil dune called Muraikibat (Plate 10). It is over 30 feet high in places, and its disconnected remnants are almost exactly 1 kilometre in length. Similar dunes exist elsewhere in Hasa, and there is one on an islet off the coast. On Bahrein Island no such dunes are to be found, but in certain canyons there exist beds of slightly indurated sands. Like the fossil dunes they are cross-bedded and consist of quartz grains coated with calcium carbonate. These various sandstone masses, designated the Miliolitic formation, are almost certainly of the Pleistocene period. It seems likely that they were formed in the last pre-glacial and solidified in present form during the more humid climate of the final glacial state.

The most interesting feature of Muraikibat sand-hill is that its long axis points to the north-west. At the time of its formation therefore the wind came at right angles to the ridge, or from the north-east. As the prevailing winds of the present day are from the north-north-west, it is obvious that there has been a very radical change. The reason for this is not yet known, but I think that the explanation may hinge on the probability that the trade-wind belt expanded sufficiently during inter-glacial epochs to affect north-eastern Arabia.

On the south-western sloping face of Muraikibat there are more than a score of curious pits (Plate 7). These vary in size and shape: some are about 2 feet long by 1 foot wide by 8 inches deep, but others are about the size of a small coffin. Upon close inspection I found that sandstone blocks of any serviceable shape hardly could have been quarried; on the contrary, the making of a pit seemed to have been the primary purpose. Yet many of the cavities would not hold liquid, nor would they be large enough to serve as ordinary graves. The only explanation I can offer, and I do so hesitantly, is that some time in the past this fossil dune may have served as a crude *dakhma*, or "Tower of Silence." Here followers of Zoroaster's creed may have exposed dead bodies to the vultures and wild dogs. The Sassanian monarch Shapur II conquered Hasa in A.D. 320, and even before then many Iranians must have dwelt along this shore.

Dammam itself contains little of interest save for its large stone fort or castle, which stands offshore just north of the town. The castle is built on a coral reef, and the place is surrounded by water at high tide. A few ancient cannon lie rusting in the castle, which at one time must have been a keep of decided strength. Unfortunately, history has left us hardly any records of

Dammam's past, and the builders of the castle are unknown. There seem to have been several successive buildings. The earliest may have been the work of Arabs or Iranians, although the bulk of the present building is generally believed to be of Portuguese construction. It is certainly true that the Portuguese conquered Hasa early in the sixteenth century, and that they built a fort at Qatif, or "Catifa," as D'Albuquerque calls it. That the Dammam castle is also their work can only be inferred from its similarity in several respects to the great Portuguese fort on Bahrein Island, and from the fact that the Portuguese, who owed their dominion in the Persian Gulf to sea power, had a liking for forts that could be reached directly from the water. In 1625 for example they built at Kung, on the Iranian coast, a masonry fort which at high water was surrounded by the sea. Dammam fort was also the stronghold of Rahma ibn Jabir, the notorious and utterly fearless pirate who terrorized the Gulf for twenty years at the beginning of the nineteenth century. He has been called "perhaps the most successful pirate that ever infested any sea."

The coastal area which stretches for 11½ miles from Dammam to a little beyond Qatif is by far the most thickly populated section of the Hasa littoral, and there is ample indication that such has been the case ever since the Bronze Age. Flint tools, potsherds, and metal objects litter scores of acres of ground, and yet the dunes have rolled over and covered an even larger area. The debris of centuries is mixed haphazard, and I picked up many pieces of medieval pottery, some of them probably brought from Hormuz, Iranian bangles of many colours, coins of bronze or copper, and countless stone and flint implements.

About the end of the tenth century A.D., Chinese junks began to lumber up the Persian Gulf to the ports of Iran and Arabia, and to-day old Chinese money is frequently picked up in the Qatif area. Two coins which I found proved to belong to the reigns of Shao-Sheng (A.D. 1094–1098) and Shao-Ting (A.D. 1228–1233). I also found examples of the old coinage peculiar to Hasa. This is the *tawila*, or "long bit," a piece of copper with a small amount of silver in it. It is shaped rather like a V, but with one prong straight and the other slightly curved. It is said to have been made by one of the Carmathian Princes about the year A.D. 920. Until the coming of the Turks in the last century, the *tawila* apparently was accepted at the rate of seventy-five to a Maria Theresa dollar.

One medieval ruin-field centres about a point 7½ miles north of Umm ar Ruus, and there is a good well near it. According to a local Arab legend, a city stood here long before the Portuguese came. It was the seat of the ruler of this part of Arabia, but "a sickness" broke out which destroyed all the inhabitants. In consequence it "was looked upon as an evil place, and no one settled there again." An oil man who knew of this legend told me that near the modern town of Al Khubar there is a village that was wiped out by smallpox decades ago, and that even to-day natives cannot be persuaded to go near the place.

The receding shore-line has left the medieval ruin-fields completely deserted, for the native settlements have moved eastward to the new shore, and there are thus two parallel strips of habitation sites: the old one, now in

part buried under dunes, and the present-day series of gulf-side towns. The distance between these strips varies between 2 and 3 miles. From the evidence of pottery finds, it would seem that the recession of the shore-line took place gradually.

It will be seen from the map that there are several old habitation sites in the Qatif area; but the largest of these, and the only one which shows the ruins of a large town or city, lies 3½ miles west of Qatif. Here there are the easily traceable foundations of old houses, and on the surface one finds medieval Arab coins and pottery. A few of the larger coins belong to the late Abbasid period, about the tenth to twelfth century A.D. Bronze ornaments occur in profusion. The dunes have overrun part of the site, and one large dune cuts the old city almost in half. Between this city and what Palgrave describes as "the dark plantation-line that girdles Ḳaṭeef itself landwards" is a large area half covered by dunes. In the parts that are free of sand there is a gravel floor thickly littered with sherds and other debris. But the most curious sight is the long line of old wells (Plate 9). The water in them is artesian and warm (84°), and flows eastward in subterranean tunnels, from which cylindrical shafts rise at intervals, piercing the dunes. In some cases only the very top of the shaft appears above the sand; but elsewhere the dunes have passed by, leaving the masonry columns towering awkwardly behind.

This irrigation system is of the Iranian *kariz* type, and, according to local tradition, was built "long before the time of Islam." Since we know that about A.D. 320 Shapur II conquered this whole Arabian littoral, beginning at Qatif, it seems quite possible that the original stone irrigation-channels were built not long afterwards, although the present structures doubtless date in large part from a much later period. The wells themselves are certainly of great antiquity, and according to Arab tradition they were originally in the centre of the date-gardens.

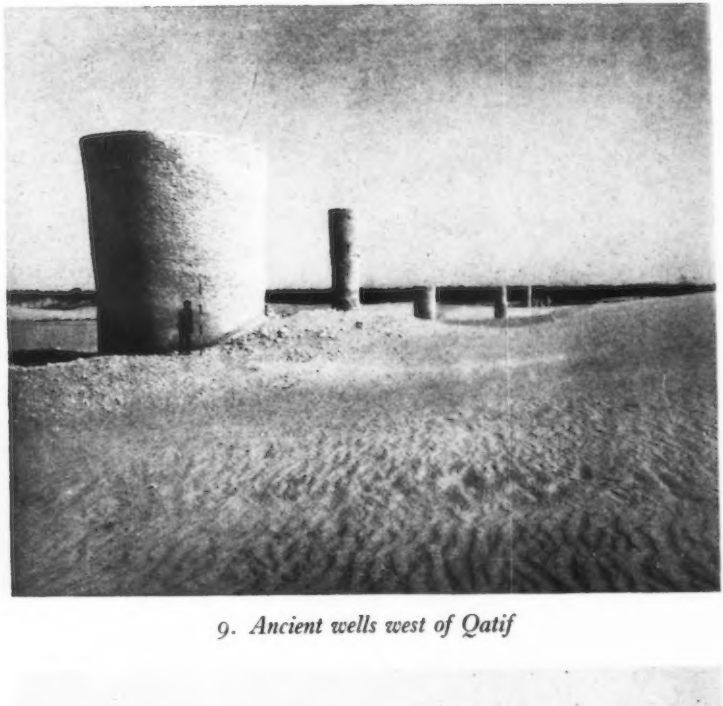
While most of the objects which I found in the ruined city to the west of the walls are medieval in date, it is possible that this was also the site of the ancient city of Bilbana, which Ptolemy locates hereabouts. In any case there can be no doubt at all that in this particular region there have been settlements of one sort or another for thousands of years. Among the Graeco-Roman geographers Pliny gives the only detailed description of this Arabian littoral:

> "We will now proceed to describe the coast from Charax (below modern Basra) onward, which was first explored for King Epiphanes. There is the place where the mouth of the Euphrates formerly was, a salt-water stream; Cape Caldone; an estuary more resembling a whirlpool than open sea, stretching 50 miles along the coast; the river Achenum; 100 miles of desert, extending as far as Icarus Island; Capeus Bay, on which dwell the Gaulopes and the Gattaei; the Bay of Gerra and the town of that name. . . ."

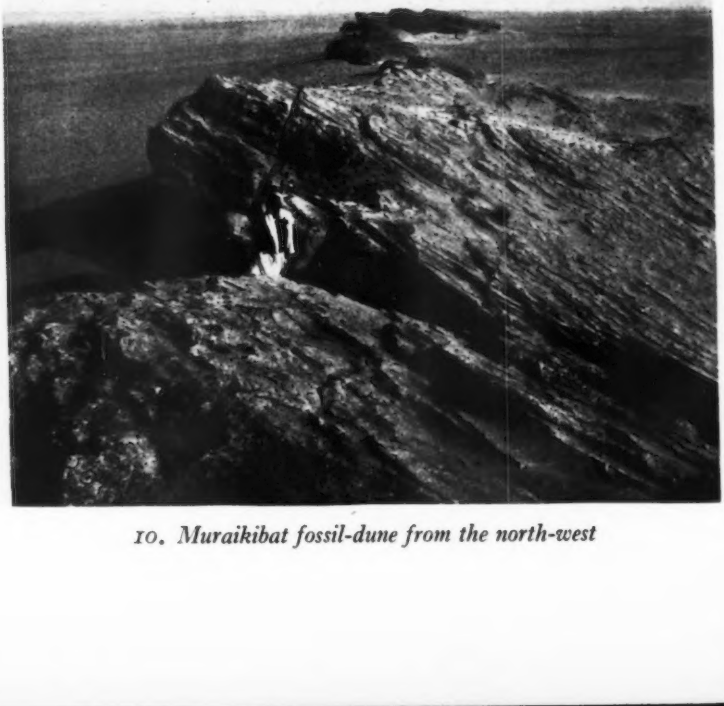
Despite some vagueness, this account can, I think, easily be understood and interpreted by any one familiar with the topography of the Hasa littoral. The "desert tract" must refer to the bleak and almost uninhabited coast as far south as the little island of Jinna, which is conceivably the Icarus of Pliny. Some geographers have supposed that Abu Ali was Icarus, but in reality Abu Ali is not an island but a reef with dry land at low tide. Jinna, on the contrary,

7. A pit in the south-west face of Muraikibat

8. Lower Palaeolithic hand-axe found in situ at Duwadami: length 7½ inches



9. Ancient wells west of Qatif



10. Muraikibat fossil-dune from the north-west

has some cliffs on its north-eastern side that are about 35 feet high. Moreover, the island has abundant fresh water, and there is a harbour on the north, where a fishing town is situated. Yet there are objections to identifying Jinna with Icarus, not least of which is the fact that other classical geographers state that Icarus (var. Icnara) is quite near the mouth of the Euphrates.

Nothing is said by Pliny of the coast between Icarus and Qatif, but the Bay of Capeus undoubtedly is Qatif Bay, and the name of the Chateni tribe is preserved in Qatif. As we have seen, the Bay of Gerra can be identified with the gulf outside 'Uqair and Salwa. Obviously Pliny's information is based on rough observations made from a ship proceeding southward along the coast, so it is not surprising that the account is incomplete and that it deals principally with the two old seaboard trading districts at Qatif and 'Uqair.

The date-gardens at Qatif, although by no means as extensive as those around Hofuf, cover an area about $6\frac{1}{2}$ miles long by 2 miles wide (Plate 11). Oil geologists believe that at one time it was probably four times as great in size, and that production may have been two or three times what it is to-day. In some places I was shown palm seedlings growing on the top of waves of sand, and it was suggested to me that these seedlings might give some indication of the extent of the old date-gardens.

In appearance the city of Qatif is far from impressive, and Palgrave's description of it is still quite apt:

> "The town itself is crowded, damp, and dirty, and has altogether a gloomy, what for want of a better epithet I would call a *mouldy*, look; . . . The ill-favoured and very un-Arab look of the shopkeepers and workmen confirms what history tells of the Persian colonization of this city. Indeed the inhabitants of the entire district, but more especially of the capital, are a mongrel race, in which Persian blood predominates, mixed with that of Baṣrah, Bagdad, and the 'Irāḳ."

From Palgrave's account of his journey from Hofuf to Qatif it is clear that he skirted the Dammam Dome area on the west, thus failing to see the tumuli fields. But he does mention "Djebel Mushabhar, a pyramidal peak some seven hundred feet high and about 10 miles south of Ḳaṭeef." Presumably he is referring to Ǧabal Madhra' ash Shamali, which is actually 15 miles south of Qatif. Palgrave then reached the coast at a point a little south of Qatif, and entered the city by the western gate.

The inhabitants of the city do indeed, as Palgrave observed, differ much in appearance from those of Najd, and in general the former are smaller in stature and less enterprising by nature. In Hasa most of the people remain Shia', although at Hofuf, the capital, Sunnis are said to predominate.

Hearing that an ancient statue and an inscribed stone tablet had been seen some years previously at a place near Qatif, and that they had since been reburied, I set out with a gang of coolies and obtained permission from a local shaikh to search in his gardens for these objects. We had little luck at first, since the shaikh could no longer recall the exact location of the cache; but eventually a metal surveying rod, used as a probe, struck stone, and soon we had both pieces above ground (Plates 12 and 13).

The inscription which I found cut on the tablet is a Sabaean epitaph:

"The tombstone and grave of Eliya (Elijah) the son of 'YNY the son of Šaṣar of the family of SMM of the clan of D' L of the tribe of Šawḏab. 30." [1]

Three other inscriptions in the South Arabian script had already been found in Hasa. Two were discovered by Captain W. H. I. Shakespear in 1911 at Thaj and Hinnat.[2] These places lie some 40 miles inland from the coast and are about 83 miles west-north-west of Qatif. The third inscription,[3] which is in the possession of the Shaikh of Kuwait, is said to have come likewise from Thaj. The author of this latter inscription was, like Eliya, a member of the tribe of Shadhab, but of another clan: YD'B.

Perhaps the most interesting point about the inscription I found near Qatif is that the name Eliya (Elijah) suggests that the author of the epitaph may have been a Christian. The form of the name is Syrian rather than Jewish, and one would not expect a pagan Arab to bear this Biblical name. Professor Winnett has pointed out that a presbyter named Eliya, from Al Hira, resided at Najran in the Yemen when that city was attacked by the Jewish Dhu-Nuwas in A.D. 523. The two Eliyas cannot be identified, but the spelling of the name in the Syriac source agrees perfectly with the spelling of the name in this Sabaean inscription from Qatif. From this and other factors, the tablet may be assumed to date from the fifth or sixth century A.D.

These four inscriptions from North-eastern Arabia have this in common, that all begin with the phrase *wgr wqbr*, which occurs nowhere else in South Arabic. Probably they should be considered a separate class of Sabaean. The authors were evidently indigenes who through commercial contacts with the Yemen had become acquainted with the art of writing.

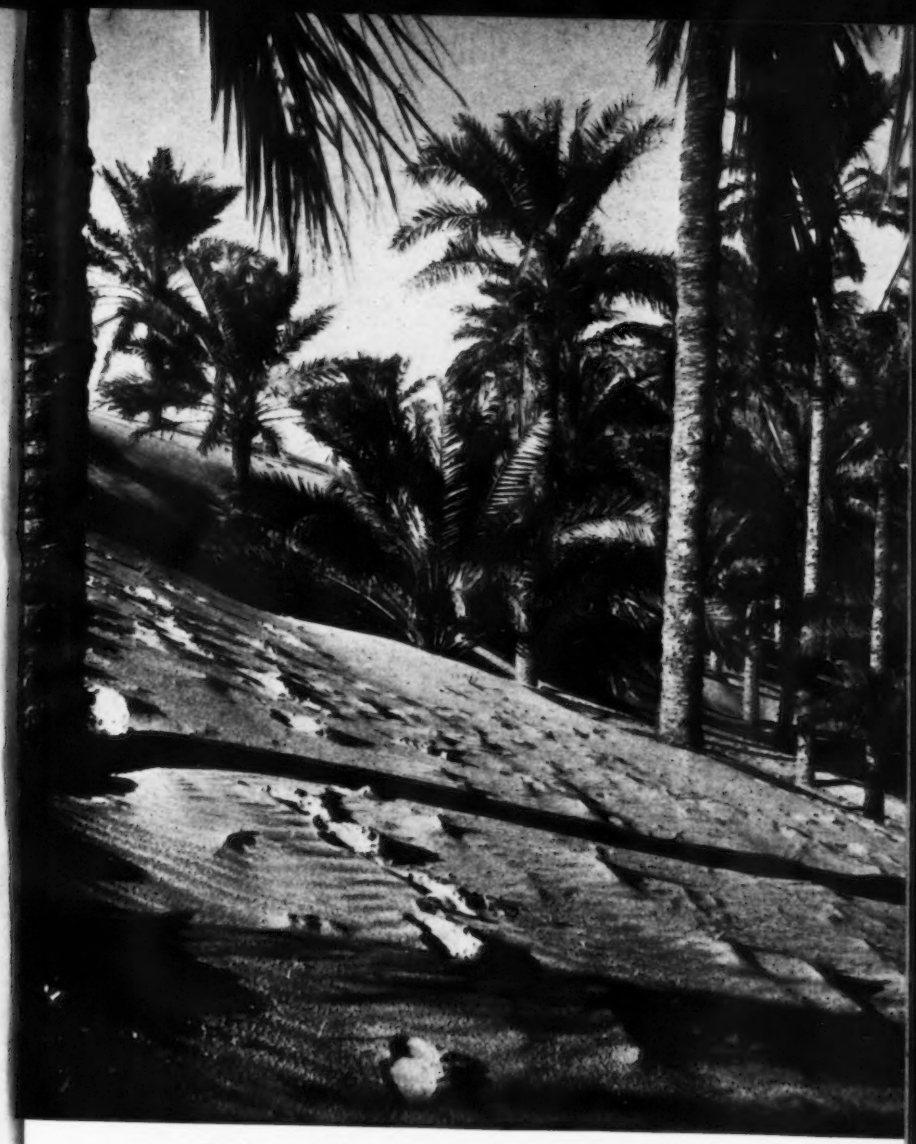
Shadhab means "tall and well built, of high breed." No such tribe is mentioned in Arabic sources, but it may have been known generally under another name. As for the "30" at the end of the text, this also is without parallel in South Arabian inscriptions. Apparently it indicates the age of the deceased.

Although there is a possibility that this Qatif tablet came originally from Thaj, the source of the other three inscriptions, I incline to the theory that small clans of the Shadhab tribe may have been located in various parts of North-eastern Arabia. Thus Eliya was perhaps a Christian residing at Qatif. The chronicle of Arbela records that Christianity had early taken root in the lands bordering the Persian Gulf, and as early as *c.* A.D. 225 certain regions were organized as bishoprics. From this period date some Christian monuments on the island of Kharj, near Bushire. Furthermore, we know that by the seventh century the province of Catare (equivalent to Bahrein Island plus Hasa) held five sees: Dairin, Talon (*Tlwn*), Khata, Hajar, and Maschmahig. The first four names can, I think, be identified with some certainty: Dairin with Darin, the principal town on Tarut Island; Talon (*Tlwn*) with Bahrein Island (since Tylus was the latter's name in the classical period, and Dilmun or Tilmun was its name in Babylonian times); Khata with Qatif; and Hagar

[1] For an excellent translation and much helpful information I am indebted to my friend Professor F. V. Winnett, of Toronto University.

[2] See *Geogr. J.* 59 (1922) 321–332.

[3] See *Le Muséon*, 51 (1938) 239–76.



11. Sand encroaching on the date gardens of Qatif

Plate 12

Plate 13

Tablet, with Sabaean inscription, and statue dug up in Qatif gardens

with the former city of that name in the Hofuf region. Christians were also very strong around Al Hira, in south-west Mesopotamia, and Nestorian missions penetrated the interior of Arabia.

The city of Qatif is known to have contained many Christians and Jews at the time of the Prophet's unification of Arabia, and among a number of old sculptured reliefs shown me by Mr. Belgrave, Adviser to the Bahrein Government, were some purportedly from Qatif and apparently Christian in inspiration. One stone has a large cross of a shape common in the seventh century.

Recently, in the summer of 1945, my friend Mr. Belgrave very kindly sent me the text of an inscription found by an educated Arab, who reported that it was carved on a stone near Qatif. Dr. Winnett's translation is as follows:

> "The tombstone and grave of Šibām the daughter of Ṣuḥār the son of 'NNHL the son of Šamīt of the people of Yd'B. 90."

It will be recalled that the author of the third inscription from Thaj was likewise a member of the clan YD'B, which was included in the tribe of Shadhab. Consequently we may conclude that the author of this newly found inscription belonged to the Shadhab tribe, as did the Eliya of the tablet I uncovered. This fact seems a further indication that the Shadhab tribe was spread along the upper Persian Gulf.

As with the other Qatif tablet, this inscription ends in a letter to which it seems necessary to assign numerical value. So the woman, Šibām, was presumably ninety years of age. The date of the inscription is, like the other one from Qatif, probably fifth or sixth century A.D.

The statue which I dug up in 1940 is of local limestone, and in its present form is approximately 3 feet in height. The head and shoulders are lacking, quite possibly having been rudely knocked off by Wahhabi "idol-smashers." I was told by the local shaikh that it was first uncovered on Tarut Island. There seems to be no reason to doubt this statement, for a number of statuettes similar in style have been discovered there by Arabs. It is said that gold coins, also, have been found on Tarut, although unfortunately I was unable to locate and see any of these objects. The statue does not appear to have any exact parallels, but it is in Babylonian and Iranian tradition. Over the tunic the man wears an overcoat in the style of the Iranian *Kandys*, typical for Iran in the Parthian time and taken over by the Parthians from the Iranian past. Professor M. I. Rostovtzeff, now of Yale University, has given me his opinion that in general the dress of the Tarut statue is "a variation of the Irano-Semitic dress which is typical for Palmyra and Dura during the first three centuries A.D." He thinks that the figure may represent a priest, assisted by a boy, in the act of performing a sacrifice. In point of time it very probably belongs to the second or third century of our era.

My next objective was a visit to Tarut Island, whose history and topography are almost unknown. In Ptolemy's map of Arabia the island called by him Tharo is placed about where Tarut is located, and the two may be taken as identical. According to Arab tradition the original name of the island was Ashtarut, and this is very likely true. The name is West Semitic and is

probably derived from Athtar, equivalent to the Babylonian Ishtar. It is most interesting to find this connection in the name of Tarut, for the worship of a mother-goddess is extremely ancient in these parts, going back to at least the third millennium B.C. The Sumerians associated their mother-goddess with Dilmun (*i.e.* Bahrein Island), and one liturgy tells how Ishtar washed her head "in a fountain of Mount Dilmun." The Greeks who explored the Persian Gulf for Alexander identified the goddess worshipped in this region with Venus.

Some confusion has resulted from the fact that during the Middle Ages Tarut Island was known generally as Dairin or Daryn, which is actually the name of its principal town (Darin). There are references to Dairin as an insular see of the Nestorian Church, and the place was renowned as an emporium for spices and musk imported from India.

Three days before Christmas, 1940, I set out from Al Khubar in an Arab coastal boat, and headed north towards the island. On this day the *shamal*, or north-wester, was blowing very briskly and the sky was overcast. It required more than three hours to reach the island, which at a medium distance resembles a scene from the voyages of Sinbad the Sailor; for the steep walls of Darin cover most of its southern side and give it the look of a city rising abruptly from the sea. Mention has already been made of the drop in the Persian Gulf's water-level. Perhaps nowhere has this recession had a more noticeable effect than at Tarut, and the island is now very difficult to approach by boat. It is surrounded by a very wide shelf of hard sand, and between it and Ras at Tannura it is possible to cross on foot quite easily at low tide, when the water is only a foot deep. At high tide it approaches 5 feet.

In the early days of Islam there were still many Iranians (Magians), Jews, and Christians in Qatif and the other settlements of Hasa; and when the Prophet died there was a general rising here against the Muslims. Indeed, this district was one of the first to proclaim its independence of the hegemony of Madina. Abu Bekr, the successor of Mohammed, quickly sent forces into North-eastern Arabia, and a local tradition preserves an interesting incident in the fierce fighting which ensued. It seems that the host of Islam was held off by the defenders of Tarut, mainly through the difficulty the believers had in attacking across water. Then, so the story goes, Allah dried up the waters, and the Muslim forces swept over and stormed Darin. Supposing that there is a grain of truth in this tale, and remembering that the Gulf water-level was higher at that time, it is possible that an unusually low tide permitted the Muslims to wade across easily, and that in this manner Tarut's "water defence-line" was overcome.

To-day the island's harbour is nearly useless, and the few inhabitants win a precarious living from fishing and from a date-garden which stands on the low ground at the island's northern end. I was not able to explore the entire island, but at the southern tip I could find no traces of ancient buildings. Just north of Darin however is a field of crude, irregular mounds, which the natives say is an old burial ground. Here and there among these mounds I picked up some odd stone objects, mostly of igneous rock. Several of the place-names of Tarut Island have an Iranian sound, for example Zaur and Sanabis.

Stretching north from Qatif is a very wide belt of *sabkha*, desolate and forbidding. Camel trains shamble across this waste *en route* to Jubail and Ma'qala, but in wet weather it becomes a treacherous bog, and then only the hard-packed earth on the main road gives any solid footing. A few small villages are scattered along the coast-line between Ras at Tannura and Jubail, which is a town with a fair-sized harbour and bazaar, serving as a regular halt for camel caravans.

The district immediately around Jubail is flat and featureless except for an occasional fortified well or clump of palms. But just 4 miles south-west of Jubail is 'Ain al 'Id, a large and ancient well. Around it there has gradually accumulated a great mound of camel dung, and the ruins of several old buildings are to be seen near by. Proceeding southward from 'Ain al 'Id, we thoroughly explored Jabal Barri, the only hill hereabouts. I had half expected to discover flint artifacts there, but none could be found. A study of the topography soon provided one explanation: the *jabal* is surrounded on three sides by very low ground, which from the late Pleistocene to perhaps Christian times was almost certainly a marsh. Thus the hill would have been inhospitable and too isolated from game centres to have been a satisfactory location for primitive hunters. On the other hand, on top of Jabal Barri are the stone ruins of a town, composed of oblong houses separated by streets, the whole laid out in a quite orderly pattern. This strange place is totally unlike any modern settlement in Hasa, and it is hard to find an explanation for its presence here. It is a true hill-town, and how sufficient fresh water was obtained by the inhabitants is a most perplexing question. Possibly wells then existed near the foot of the *jabal*, and from these water was carried up laboriously in skins or jars. Yet I could find no traces of reservoirs in the houses. Amid the ruins are a good many potsherds, mostly of green and blue glass and dating hardly earlier than the beginning of the second millennium A.D. There is no wall around the town, but the situation is defensively strong; mounted raiders would have been unable to storm the place without great difficulty and heavy losses.

From time to time I had heard reports of the presence of "cliff-castles" about 85 miles west of Jubail, and at length preparations were completed for a trip into that district. On the way from Jubail to Hinnat I saw nothing of particular interest. The route ran through the *dakaka*, and to make the journey in a car was much like riding in a small power-boat over an endless series of rolling waves. Hinnat I found to be a picturesque little town in a shallow basin well supplied with water. It was here, and at the site of Thaj, which apparently lies about 5 miles south-west of Hinnat, that in 1911 Captain Shakespear found his Sabaean inscriptions. We had a long day's trip ahead of us, and to my deep regret there was no time to turn aside and examine Thaj, which is surely deserving of future attention. I heard that the site is a large one, and that it differs from those around Qatif in having many sherds of a red ware in place of the medieval green-glaze. This circumstance is quite in keeping with the known antiquity of Thaj, which appears to have lain on an ancient caravan route connecting Mecca with the Lakhmid kingdom of Al Hira. Thus the place was open to active and contrasting cultural influences. I was told that at the northern end of the site stands the modern

town of Thaj. Now ruinous and deserted, this place is said to have been inhabited formerly by Beni Khalid, and to have been destroyed by Wahhabi and 'Ajman attackers.

From Hinnat wells we continued westward, into country differing greatly from the Hasa littoral. Somewhere here was the beginning of Najd, although it seems impossible to say precisely where is the "line" separating it from Hasa. Brown *dibdiba* plains stretched before us, fading away into the far horizon; and occasional mesas gave a touch of grandeur and beauty to the landscape. Here, I felt, was the frontier of the true Arabia: that mysterious wilderness whose pastoral life is an odd mingling of harshness and serenity. Despite its desolation the scenery gives one a strong feeling of peace and relaxation, a sense of freshness and remoteness, as though one were living in the early morning of the world.

Eventually we entered the Wadi al Miyah, which is really a series of small elongated closed basins, in a long north–south zone, somewhat lower than on either side. Toward mid-afternoon we approached the easternmost escarpment, and about 6½ miles south-west of the village of Muraigha we came upon our first "cliff-castle." It turned out to be a small, walled settlement perched on top of an isolated mesa, and the mud-mortared stone walls were built so close to the sides of the mesa that it offered no easy way of entry. Within the walls and also on the slopes round about were flint bird-arrowheads and quantities of potsherds, mostly of yellowish paste with decorations of parallel lines and thumbnail patterns. In the rock floor of the "cliff castle" is a well, now partially filled in by debris, and at one point in the settlement's protecting wall a small limestone platform juts out slightly. In this is a round porthole, evidently arranged so that a rope-ladder could be let down or supplies hauled up. As only one person at a time can enter through this hole, it must have been designed as a further safeguard against sudden attack. The place appears to have been abandoned for centuries, but it is almost certainly post-Islamic: perhaps a relic of that turbulent epoch when the Carmathians made the province of Bahrein a battleground.

We camped that night 24 miles east of Qariyat as Sifla. During the evening there shuffled into the tent an ancient Arab, reputed to be one of the best guides in the peninsula, a man who "knew Arabia from the Rub' al Khali to the Wadi Sirhan." By lamplight we discussed the topography of the north-east, and I asked particularly concerning the existence of caves. He knew of none however and was of the opinion that the "cliff-castles" are the only notable ruins in the region.

We were up before dawn the next day, and after a quick breakfast started out for Mulaija. A little over 4 miles south of this town I came across another mesa-settlement, in a more ruinous state than the first, but of the same general design. The top of the wall is about 100 feet above the level of the plain, and the settlement's dimensions are 65 yards by 28 yards. Less than 2 miles to the east is a third and even more imposing place of this character. Here the mesa was too long to be encircled by walls; so the settlement was built at one extremity, and a "moat" was laboriously cut through the rock, to a depth and breadth of about 10 feet. In this castle, likewise, I found a well in the centre, driven down to a depth that must be very considerable. From

the number of potsherds present these mesa-settlements seem to have been true habitations and not merely the fortresses of the people who built them. Yet it is hard to see how in the event of an enemy raid any animals could have been safeguarded.

Around Mulaija stretch *dibdiba* plains, bare except for occasional palm clumps surrounding a few wells. West of Abu Hadriya we came to Ar Rudaif, a hill 282 feet high. Here there are a dozen or so burial mounds, and near them I dug up a few worked chert pieces. The material used is a white Miocene chert, obtainable at several places in North-eastern Arabia, notably near 'Ain Dhabitiya, 65 miles south of Ar Rudaif. The various chert pieces from Ar Rudaif are apparently Chalcolithic-early Bronze Age in type, and one is a very beautiful pressure-chipped spearhead.

From Abu Hadriya to Jubail the route is devoid of interest, but Jinna Island and the mainland nearby might well repay exploration. At Jabal Hadrukh, 32 miles to the north-west of Jubail, I found a stone dish of primitive type. Had I been able to do so, I certainly would have examined the coast-line from Jubail north to the Neutral Zone. The region around 'Ain Dhabitiya might also repay attention; and I heard that at Ma'qala, about 165 miles west of Qatif, there are great, underground river-bed caverns. One man told me that he had been 1500 feet into one of them. He reported that nearby he had picked up large stone pestles, one more than 15 inches in length.

In this narrative I have tried to give a general account of my field trips, of the problems encountered, and of the discoveries made. It will be realized that the dating of sites and finds cannot be other than tentative at present, for in comparison with other countries the long tumultuous past of Arabia provides pitifully few milestones to help an archaeologist find his way to the truth.

It has been the fate of Hasa to be almost forgotten by the outer world during long periods of history, but at other times to be of primary importance. Perhaps its greatest days were during the Graeco-Roman period, when the Persian Gulf possessed a number of thriving cities on the commercial routes between India and the Mediterranean. The reasons why they were situated here, rather than on the southern shore of Arabia or along the Red Sea, were clearly set forth in 1880 by Sir Henry Rawlinson:

> 1. "In the infancy of navigation mariners dared not strike directly across the Indian Ocean from the Malabar coast to Aden, but were obliged to creep along the shore from the mouth of the Indus to the entrance to the Persian Gulf.
>
> 2. The Persian Gulf, with its varying winds, was always a far more convenient sea for navigation than the funnel-shaped Red Sea, where the wind blew for nine months continuously in one direction, and for three months in the other.
>
> 3. The valley of the Euphrates and the northern skirts of Arabia (along the caravan route, for instance, from Gerra to Palmyra), offered far greater facilities for inland transport to the west, than the hot trackless wastes of the centre of the peninsula."

To-day Gerra is little more than a ruin-field and a name, while Darin retains no substance of its former affluence. But the discovery of oil has again

brought Hasa into prominence, and in the future it seems destined to become the most progressive and valuable district of the Saudi Arabian kingdom.

In closing I should like to express my deep regret at the untimely death of Sir Arnold Wilson. I had looked forward keenly to having his further comments on many matters connected with the Persian Gulf, a subject which he had made his own. No one who takes an interest in that fascinating part of the world can fail to acknowledge a debt to him for the ability with which, in word and deed, he brought to the fore the great problems, and the great possibilities, of the Persian Gulf.

GEOGRAPHY AND GEOGRAPHICAL STUDIES IN FRANCE DURING THE WAR AND THE OCCUPATION

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GEOGRAPHY IN FRANCE underwent a long period of restricted activity between 1940 and 1944. The number of considerable works which appeared during these four years is deceptive: none of them were planned or written during the war; they derive in reality from the fruitful pre-war period, and some were in the press at the outbreak of hostilities.

Physically and spiritually French geographers found it impossible on account of the war to work effectively even in their own country, where difficulties of travel multiplied endlessly. Most of them were limited to resuming and completing modest studies for which they had already assembled the material: in this way it was possible to maintain some slight activity in publication. Deprived of all news and under strict surveillance, teachers of geography found themselves almost completely forbidden access to sources of economic documentation and prohibited from publishing articles containing statistics, even if out of date, or maps bearing upon possible theatres of operations. The German censorship prevented the publication of several articles on the physical structure of the coasts of France, the climate of North Africa, and pre-war traffic on certain French railway systems. Later the rationing of paper forced French geographical periodicals one after the other to cease publication, the *Annales de Géographie* alone being able to continue, smaller in size and with its issues reduced from six to four a year. In order to survive it was further obliged to amalgamate from the beginning of 1940 with *La Géographie*, the organ of the Société de Géographie de France. In turning over the pages of the new publication, known thenceforward as *Annales de Géographie. Bulletin de la Société de Géographie*, one sees clearly that the majority of the articles and notes are based upon pre-war research and travel.

French geography suffered not only from this creeping paralysis: its very existence was assailed through the premature deaths of several of its leaders. J. Sion, professor at the University of Montpellier, and A. Demangeon, professor at the Sorbonne, scarcely survived the defeat of France. The former died in June 1940, the latter a month later after a short illness aggravated by the immediate consequences of the occupation. Then at the beginning of 1941 came the severe loss of L. Gallois, one of the earliest pupils of Vidal de la Blache and one of those who had contributed the longest to developing the French geographical school in accordance with his teaching. The following years saw the deaths successively of A. Albitreccia, who had recently published his work on Corsica; Ch. Robert-Muller, whose work on the fishermen of the Atlantic coast of Brittany is still unpublished; P. Camena d'Almeida, a well-known authority on Russia; P. Labbé, one of the last French explorers of Russian Central Asia; and Ch. Rabot, an authority on the geography of Scandinavia; and finally C. Vallaux, the eminent oceanographer, who died soon after the Liberation.

To these gaps in the ranks of French geographers must be added those due to the reprisals of the enemy during those four tragic years. When the German grip tightened on France, teachers of geography were not the last to suffer; their school embodied the traditional resistance to the pseudo-scientific theories of German "Anthropogeographie" and "Geopolitik," of which, across the Rhine, Haushofer was still the representative, in turn the inspirer and the zealous servant of national socialist theories on "living space" and the mission of the Germanic race in the "new" Europe. The role of those who suffered between 1942 and 1944 is long: Th. Lefebvre, professor at the University of Poitiers, killed by the Germans after a long imprisonment; J. Ancel, professor at the Sorbonne, who died in the Drancy concentration camp; R. Musset, professor at the University of Caen, who for two years experienced the horrors of Buchenwald; H. Baulig, professor at the University of Strasbourg (evacuated to Clermont-Ferrand) imprisoned for several months; E. Colin, editor of the *Bibliographie Géographique Internationale*, arrested for aiding allied airmen brought down in Brittany. It would be too long, indeed impossible, to list all the geographers, teachers in various Lycées in France, who, while still too young to have made reputations, were arrested, interned, deported, or executed. Those who put aside their studies to devote themselves to the clandestine activities of the Resistance were also numerous. Many of the *maquis* of the Limousin, the Jura, Vercors, and Ile-de-France, were regularly supplied with the large-scale maps indispensable for their operations, or even for their security, by teachers of geography from their private collections. This underground activity was also evident in the camouflaging of collections of maps persistently sought for by the occupying forces. Thus the transfer of the library and collections of the Société de Géographie to the Bibliothèque Nationale was made the pretext for losing all trace of the innumerable maps and charts in its possession. I confine myself to recording the names of P. Gourou, professor at the University of Bordeaux, who was vice-president of the Comité régional de Libération, and J. Blache, professor at the University of Nancy, who was later to become Préfet of Meuthe-et-Moselle after the departure of the Germans.

In considering the total of principal works which appeared between 1940 and 1944 or after the liberation, one notices a strong preponderance of studies in regional geography. Works of synthesis on abstract problems of physical or human geography are rare. This is to be attributed without doubt to the demands of higher education in France. Our great universities in general have each a single chair of geography only. With the exception of the Sorbonne, now abundantly provided with chairs in physical, economic, human, regional, and colonial geography, the Universities of Lyon and Strasbourg alone had two chairs before the war. Bordeaux has had a second chair since 1943 only, and Rennes and Lille for an even shorter period. A French professor of geography must therefore be capable of introducing his students to all branches of geography. For this reason candidates for the *doctorat* naturally tend to look for research subjects which will allow them to display their competence in most aspects of geography, and not in one limited section alone. Thus it is not surprising that the majority of theses for the *doctorat* published since 1940 have been, as in the past, comprehensive regional studies.

The last thesis defended at the Sorbonne before the occupation, that by F. Ruellan on Kwansai, displays this double intention, though plainly the fundamental section is a geomorphological study of the central region of Hondo.[1]

A series of works presented either as principal or complementary theses are connected more particularly with physical geography: the study by A. Perpillou on the Limousin, which analyses against the local background the principal problems of morphology and relief, climate, hydrology, and plant geography set by this region of the Massif central [2]; the big work by J. Dresch on the Grand Atlas of Morocco and the neighbouring regions of the Haouz and the Sous [3]; the monograph of R. Clozier on the Causses de Quercy, in which karst erosion and the place which it occupies in the present relief of the calcareous plateaus of Aquitaine are examined [4]; the study by J. Weulersse on the Orontes and its regime [5]; the work by Y. Urvoy on the basin of the Niger and its morphological evolution during the alternation of dry and rainy seasons which, since the Pliocene, have set a rhythm in the physical development of these Saharan borderlands [6]; the fine monograph by G. Baekeroot on the Ardenne and Luxembourg basin of the Moselle, a

[1] F. Ruellan: 'Le Kwansai; étude géomorphologique d'une région japonaise.' Large 8vo, x+821 pp. Tours: Arrault, 1940. Rev. by Emm. de Martonne in *Ann. de Géogr.*, Juillet 1941.

[2] A. Perpillou: 'Le Limousin, étude de géographie physique régionale.' 4vo, x+258 pp. Chartres, 1940. Rev. by Emm. de Martonne in *Ann. de Géogr.*, Oct. 1941.

[3] J. Dresch: 'Recherches sur l'évolution du relief dans le massif central du Grand Atlas, le Haouz et le Sous.' 4to, xx+712 pp. Tours: Arrault, 1941. Rev. by Emm. de Martonne in *Ann. de Géogr.*, Jan. 1943.

[4] R. Clozier: 'Les Causses du Quercy; contribution à la géographie physique d'une région calcaire.' 4to, 184 pp. Paris: Ballière, 1940. Rev. by Emm. de Martonne in *Ann. de Géogr.*, Jan. 1942.

[5] J. Weulersse: 'L'Oronte, étude de fleuve.' 4to, 92 pp. Tours: Arrault, 1940.

[6] Y. Urvoy: 'Les bassins du Niger; étude de géographie physique et de paléogéographie.' 4to, iv+144 pp. Paris: Larose, 1942. Rev. by Emm. de Martonne in *Ann. de Géogr.* Jan. 1945.

detailed study of the various Tertiary erosion surfaces and of the differentiation of the present relief [1]; the two books by L. Goron on the pre-Pyrenees of Ariège, their tectonics, and the role of glacial action in their relief [2]; the more recent study by P. Veyret on the alpine and pre-alpine regions of the middle Durance.[3] This list certainly reveals one of the present tendencies among French geographers: the taste for very detailed morphological analysis of restricted areas which are well known to them.

Alongside these doctorial theses, several comprehensive works have appeared. The masterly volume [4] by Emm. de Martonne on the physical geography of France forms Tome VI of the 'Géographie universelle,' the publication of which was begun under the direction of P. Vidal de la Blache and L. Gallois. It is the first comprehensive arrangement and collation of the total results of fifty years' research by French geographers into the physical geography of their country, and will long remain unequalled. Then, going beyond the domain of pure physical geography in order to present what are in effect wide regional monographs, there are the two books published in 1941 and 1943 by R. Blanchard [5]; these continue his earlier study of the Pre-Alpes, one dealing with the "Cluses préalpines" and the alpine trough, the other with the central massifs and the interior zones of the northern Alps. These works are part of the large contribution which French geographers of the Grenoble school have made to the study of this great mountain range.

I may cite also the study by P. S. Iovanovic on 'Les profils fluviatiles en long, leurs formes et leur genèse,' a study which subjects to judicious mathematical analysis the profiles of equilibrium of watercourses,[6] and that of M. Pardé, 'Quelques nouveautés sur le régime du Rhône,' which, as the author states in the sub-title, is a supplement, though indeed full of fresh ideas, to the most important work on the hydrology of rivers by one of the leading French specialists.[7]

[1] G. Baekeroot: 'Oesling et Gutland; morphologie du bassin ardennais et luxembourgeois de la Moselle.' Large 8vo, 312 pp. Paris: A. Colin, 1942. Rev. by Emm. de Martonne in *Ann. de Géogr.*, Oct. 1943.

[2] L. Goron: 'Les Pré-Pyrénées ariégeoises et garonnaises; essai d'étude morphogénique d'une lisière de montagne.' Large 8vo, xx+890 pp. Toulouse: E. Privat, 1940. 'Le rôle des glaciations quaternaires dans le modelé des vallées maîtresses des Pré-Pyrénées ariégeoises et garonnaises et leur avant-pays; étude de géographie physique.' Large 8vo, xii+464 pp. *Ibid.*, 1941. Rev. by Emm. de Martonne in *Ann. de Géogr.*, Avril 1945.

[3] P. Veyret: 'Les pays de la moyenne Durance alpestre; Bas Embrunais, Pays de Seyne, Gapençais, Bas Bochaine. Etude géographique.' Large 8vo, xx+596 pp. Grenoble: Arthaud, 1945.

[4] Emm. de Martonne: 'La France. Première partie: France physique' (*Géogr. univ.*, t. vi), 8vo, 464 pp. Paris: A. Colin, 1943.

[5] R. Blanchard: 'Les Cluses préalpines et le Sillon alpine.' (Les Alpes Occidentales, tome II.) 2 vols. 4to, 672 pp. Grenoble: Arthaud, 1941. Rev. by J. Blache in *Ann. de Géogr.* Oct. 1942. 'Les Grandes Alpes françaises du Nord. Massifs centraux; Zone intra-alpine.' (Les Alpes Occid., tome III.) 2 vols. 4to. *Ibid.*, 1943.

[6] P. S. Iovanovic: 'Les profiles fluviatiles en long; leurs formes et leur genèse. Essai de méthodes morphogénétiques nouvelles.' 8vo, xii+196 pp. Paris: A. Colin, 1940. Rev. by M. Pardé in *Ann. de Géogr.*, Jan. 1945.

[7] M. Pardé: 'Quelques nouveautés sur le régime du Rhône. Erratum et addendum à un gros ouvrage.' 4to, 198 pp. Lyon: M. Audin, 1942.

Other work, held up by the shortage of paper, will without doubt shortly appear, to add to this creditable list—even if it is only the important study by J. Chardonnet on the morphology of the southern Alps which gained for its author the degree of D. ès L.

There are several original works in human geography. Three attempts to study systematically the phenomena of human geography cartographically should first be noted: A. Perpillou has displayed the aspect and the recent evolution of the Limousin countryside by presenting cartographically the information furnished by cadastral documents separated by the interval of a century.[1] J. Dresch has shown by a series of revealing maps the distribution of native ways of life in the mountains of the Grand Atlas of Morocco.[2] Finally Y. Urvoy has depicted by the same method the ethnography and demography of the Sudanese populations between the Senegal and Lake Chad.[3]

It is to the study of ways of life and the phenomena of human geography that J. Weulersse particularly devotes his monograph on the country of the Alaouites,[4] and M. le Lannou his book on 'Pâtres et paysans de la Sardaigne.'[5]

The study on Corsica which A. Albitreccia has left is concerned also with human and economic geography; his analysis of the cadastral plan of the island in the eighteenth century is the starting-point of an evolution which he describes fully and skilfully in his principal work.[6] The posthumous work of Ch. Robert-Muller, 'Pêches et pêcheurs de la Bretagne atlantique,' also deals with human geography, a monograph on the way of life of a maritime people.

R. Clozier has limited the scope of his observations to a novel human phenomenon, the life and development of a great Paris railway terminus, the Gare du Nord, a fruitful study which illuminates in their several aspects the relations which bind urban geography to that of lines of communication.[7]

Special mention should be made of the work of M. Sorre on the biological foundations of human geography, an introduction to the problems of population through the study of the biological environment, favourable or hostile, in which man must establish himself. The book is based on a sound body of data contributed by agricultural, biological, anthropological, and medical

[1] A. Perpillou: 'Cartographie du paysage rural limousin. Essai d'utilisation rationnelle des documents cadastraux.' I. Commentaires, viii, 105 pp. II. Atlas, 21 plates. Chartres: Durand, 1940. Rev. by. A. Cholley in *Ann. de Géogr.*, Avril 1943.

[2] J. Dresch: 'Commentaire des cartes sur les genres de vie de montagne dans le massif de Grand Atlas marocain.' 40 pp. *and* Atlas. Tours: Arrault, 1941. Rev. by A. Cholley in *Ann. de Géogr.* Avril 1943.

[3] Y. Urvoy: 'Petit atlas ethno-démographique du Sudan entre Sénégal et Tchad.' (*Mém. Inst. franç. d'Afrique noire*, 3.) 4to, 52 pp. Paris: Larose, 1942.

[4] J. Weulersse: 'Le pays de Alaouites.' (*Inst. franç. de Damas.*) 4to, 422 pages. Tours: Arrault, 1940. Rev. by A. Cholley in *Ann. de Géogr.*, Jan. 1945.

[5] M. le Lannou: 'Pâtres et paysans de la Sardaigne.' Large 8vo, 366 pp. Tours: Arrault, 1941.

[6] A. Albitreccia: 'Le plan terrier de la Corse au XVIIIe siècle.' Large 8vo, 270 pp. Paris: Presses univ. de France, 1942. 'La Corse; son évolution au XIXe siècle et au début du XXe siècle. Etude de géographie humaine et économique.' Large 8vo, 296 pp. *Ibid.*, 1942.

[7] R. Clozier: 'La gare du Nord.' 4to, 294 pp. Paris: Baillière, 1940. Rev. by A. Cholley in *Ann. de Géogr.*, Juillet 1943.

authorities. It is indeed, as its sub-title states, an ecology of man.[1] J. Despois' study of eastern Tunisia should also be included among the basic works which give a prominent place to human problems.[2]

Two studies only have appeared on political geography in the strict sense. A. Siegfried succeeded in publishing in 1943 a 'Vue générale de la Méditerrenée,'[3] but it was necessary to await the Liberation before publishing J. Ancel's manual of the political geography of Europe, of which volume II, dealing with Germany, appeared in 1945 after the death of the author in a German prison.[4]

Another posthumous work is a collection of articles, 'Problèmes de géographie humaine,' by A. Demangeon: the first is published here for the first time and the others, having appeared in various reviews, are regrouped in such a way as to give the author's point of view on each subject and to display, from one study to the next, the development of his thought.[5] Before his death, Demangeon had completed a large work on the economic and human geography of France, which was to form the last two volumes of the 'Géographie universelle.' Held up from lack of paper, but still more by the desire to avoid German censorship, this work, to which Demangeon gave the last years of his life, is now in the press.

Similarly, geographical studies in the Colonies, though slowed down, were not entirely suspended. Under the direction of Th. Monod, the members of the Institut de l'Afrique noire have continued their studies of the Sahara and the Sudan. The results have appeared with almost unbroken regularity in the publications of the 'Comité d'études historiques et scientifiques de l'Afrique noire.'

To these highly specialized studies one may add a certain number of popular books which have supplemented geographical publications. Confining myself to the principal, I mention 'Le Spitzberg et la Sibérie du Nord,' by V. Romanovsky,[6] and 'Alaska,' by E. Bruet,[7] both based upon notes made on pre-war journeys; 'La Bourgogne,' a regional monograph by G. Chabot [8]; 'Géographie économique et sociale de la France,'[9] by P. George; and 'Géographie des Pyrénées françaises,' by P. Arqué.[10]

[1] M. Sorre: 'Les fondements biologiques de la géographie humaine. Essai d'une écologie de l'homme.' 8vo, 440 pp. Paris: A. Colin, 1943. Rev. by P. Gourou in *Ann. de Géogr.*, Oct. 1943.

[2] J. Despois: 'La Tunisie orientale. Sahel et Basse steppe.' (*Publn. Fac. des Lettres d'Alger*, 5e sér., 13.) 4to, 620 pp. Paris: Les Belles Lettres, 1940. Rev. by P. Marres in *Ann. de Géogr.*, Avril 1945.

[3] A. Siegfried: 'Vue générale de la Méditerranée.' 8vo, 192 pp. Paris: Gallimard, 1943.

[4] J. Ancel: 'Manuel géographique de politique européenne.' Tome II. L'Allemagne. Large 8vo, 270 pp. Paris: Delagrave, 1945.

[5] A. Demangeon: 'Problèmes de géographie humaine.' Large 8vo, xix+407 pp. Paris: A. Colin, 1942. Rev. by M. Grandazzi in *Ann. de Géogr.*, Oct. 1942.

[6] V. Romanovsky: 'Le Spitzberg et la Sibérie du Nord.' 8vo, 206 pp. Paris: Payot, 1943.

[7] E. Bruet: 'L'Alaska.' Large 8vo, 451 pp. Paris: Payot, 1945.

[8] G. Chabot: 'La Bourgogne.' 12mo, 224 pp. Paris: A. Colin, 1941.

[9] P. George: 'Géographie économique et sociale de la France.' 8vo, 224 pp. Paris: Editions d'hier, 1946.

[10] P. Arqué: 'Géographie des Pyrénées françaises.' 8vo, viii+211 pp. Paris: Presses univ., 1943.

To be complete, it would be necessary to note the numerous articles published in the various geographical periodicals which were able in the provinces to maintain some activity, at least for a time: the *Bulletins* of the geographical societies of Lille, Lyon, and Toulouse; also the *Revue de géographie alpine*, *Bulletin de la Société languedocienne de géographie*, and the *Revue géographique des Pyrénées et du Sud-ouest*. In the *Annales de Géographie. Bulletin de la Société de Géographie*, one may note the titles of forty-five main articles and more than fifty supplementary notes, without mentioning reviews and record notes. Of these articles and notes eighteen deal with problems of pure physical geography—general problems of morphology, climatology, and oceanography—concerning, in addition to France, Africa, Asia, America, and Scandinavia. A dozen are short regional monographs. The remainder are on human or economic geography. The authors, in addition to those already mentioned, include names well known to geographers: Arbos, Blache, Cholley, Dion, Faucher, Gourou, Marres, Meynier, Robequain, and those of some of their pupils, whose first essays appear full of promise for the near future.

It will be obvious that there could be no question of journeys of exploration and research. In 1940 the Guibaut-Liotard expedition to the Tibetan borderlands came to a premature end after the murder of L. Liotard in an ambush by Tibetan bandits. Some years before, the two explorers had succeeded in ascending the wild gorges of the Salween as far as the borders of Burma and China. On the latter occasion they were proposing to explore the upper valley of the Yangtze kiang.

In 1941 and 1942, a party composed of B. Flornoy, J. de Guébriant, and F. Matter was able to visit the Peruvian Andes. They established the glacial origin of the sources of the Marañon and of the small lake Ninococha. At the same time they discovered Inca ruins in the region of the headwaters at Lauricocha, and later, in the Chacapoyas region, the traces of a pre-Inca civilization.

Since the Liberation, several research missions have been able to leave for distant countries. Almost all include ethnographers, but also one or more geographers, and they have received the support of the Société de Géographie. Among those which are already starting work I record only those of J. Emperaire and Robin on the Chilean slopes of the Pacific: J. P. Lebeuf in the Dang-rek chain and the Cardamomes mountains of Cambodia: and B. Flornoy, who has left for another expedition in the upper Amazon over the itinerary covered in 1941–42.

At the present time, geographical studies appear to be enjoying renewed favour in France. It is in this branch of knowledge that the majority of the great universities register the greatest increases in the enrolment of both male and female students. Instruction has been enlarged by the creation of new diplomas, such as the "Certificat d'études supérieures de cartographie." The teaching of colonial geography tends to take a more important place than before the war, and specialist chairs have been created at several of the great Faculties. In addition the creation of a new degree in geography and of an independent *agrégation* in geography, henceforward distinct from that in history, are likely to attract rapidly those young teachers wishing later to pursue individual research.

As for the informed public, they are no longer content to-day to learn about foreign countries from newspaper articles. They demand more precise and less summary information. To this is due the success in France of popular scientific literature, the production of which has not yet satisfied curiosity in all branches of knowledge. During the war the majority of Frenchmen heard of distant countries as theatres of operations which they recognized as critical for the course of the war and for the future of their country, but of which even the names were scarcely familiar to them. From the realization of this lack, and the surprises which the war has revealed has now sprung without doubt that desire to know the world better, which is certainly a good augury for the future progress of geographical science.

Note: Several of the publications mentioned are in the Society's Library, and it is hoped to obtain others. Though not stated in the footnotes, all contain maps and photographs.

COASTAL PRESERVATION AND PLANNING

J. A. STEERS

SINCE WRITING the paper on Coastal Preservation and Planning, published in the *Journal* in 1944,[1] I have been able to complete my survey of the coast and also to revisit certain important areas. The parts covered since 1944 include the Isle of Wight, the coast from Lulworth to Gravesend, and the Isles of Scilly. The surveys of parts of the Dorset, North Devon, and North Cornwall coasts, and those of Cardigan Bay, parts of South Wales, and Northumberland have been checked. Only for that section of the Dorset coast between Weymouth and Swanage have I made any change in my original assessment: the differences will be clear if the present map is compared with the folding plate accompanying the former paper. The value of subsequent visits was great, however, even if few alterations on the maps resulted from them. All my earlier surveys were made when much of the coast was accessible only with difficulty or with the help of an official pass. In 1944 and 1945 something akin to peace-time conditions prevailed, and the contrast between the Northumberland coast from Amble to Tynemouth in 1943 and the Sunday after the basic petrol ration was restored in 1945 was emphatic.

The value of a survey of the whole coastline of England and Wales is, in my view, greatly increased after taking the south-east into consideration. This near-London coast is so urbanized and artificial that if it were considered on its own merits, the result would be very misleading. To many this may be an obvious statement, but for that very reason it is worth emphasis. Those who visit the south-east coast regularly and know no other, can have little idea of what truly rural coast is like, and many who know it casually are apt to regard

[1] *Geogr. J.* 104 (1944) 7–27.

it as typical of too great a proportion of the total coastline. Along the south-east coast there are still a few beautiful and unspoiled districts: Beachy Head and the Cuckmere Valley, some of the Downs between Folkestone, Dover, and Deal (although these are not completely free from the threat of industrialism based on local iron ore), the Isle of Harty, and parts of Cliffe and Cooling Marshes are examples. Pagham Harbour is another, but its full beauty is spoiled by the proximity of the shacks west of Bognor.

The evils of a lack of planning are appallingly obvious on the Sussex coast. Travel along the so-called coastal road from Portsmouth to Seaford and note the almost continuous and extremely unsightly ribbon-development, count the number of level crossings, and examine the devious ways down to the sea through building estates whose houses often extend right to the beach. Walk along the beach fringing the Sussex coastal plain and contemplate the landward views. Consider also the position of the electric light and gas works near Brighton, the beach ribbon development between Pevensey Bay and Norman's Bay and at Shoreham, notice the seaward and landward views from the main road from Brighton to Newhaven and the growth of Seaford. It is easy to point out examples of faulty and indiscriminate development, but difficult to suggest remedies. In these notes I am not concerned with such matters, but rather to urge that since the coast is a great national asset we should in future do our utmost to use it properly. It is easy to see now that if a comprehensive scheme of development of the south-eastern coast had been evolved and put into practice even after the last war, it would have been comparatively simple to have escaped the present haphazard growth. Further, it would have been possible to give as much pleasure to those owning or renting houses in the area as they enjoy now, and infinitely more to those who merely visit it for the sake of a seaside holiday. The point that matters is that in developing other parts of our coast we must bear in mind that access to the coast for all is essential, and that in order to enjoy the coast fully buildings must be properly sited and planned and must not obstruct coastal walking or appear on sky-lines. A careful study of the Sussex and Kent coasts can teach us what not to do.

The danger of ribbon-development along the coast is shown on a small scale in much of the Isle of Wight. Except for the part between Alum Bay and St. Catherine's Point and a very few short stretches elsewhere, almost the whole is built up, in striking contrast to the rural and unspoiled nature of the interior. The very varied and beautiful coastline of a small island is not improved by rows of houses.

This is not the place to discuss the immediate housing and related accommodation problems on the coasts, but I do urge again the necessity of having a national and not a local perspective. Because a particular area is very popular there is a natural tendency to build and attract more people. It is largely the position and type of the buildings which matters in such an area, and thus the central authority alone can assess adequately the national needs. There is no reason at all why all those who wish to visit the seaside should not be encouraged to do so, but a comprehensive scheme for hostels, camps, and ordinary houses is wanted in all coastal areas. The solution of limited space in part depends on staggered holidays, not only for the workers but also for schools. It means that big new camps or even new towns are necessary.

Phot. British Council

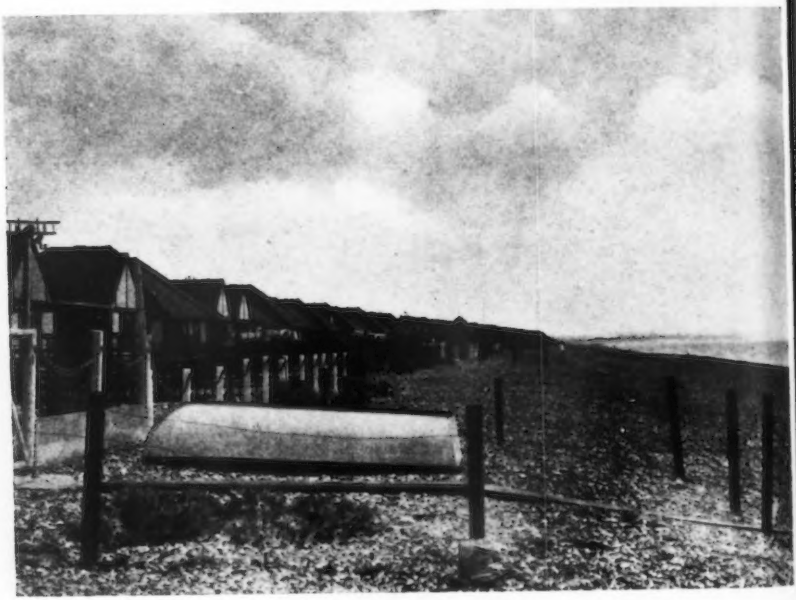
The Seven Sisters cliffs from the mouth of the river Cuckmere, Sussex

Phot. Aerofilms

Peacchaven

Phot. British Council

Sand dunes, West Beach, Littlehampton



Pevensey Bay

For example, some of the best sands on the south coast are near Camber, where a large holiday town grew up before the war. Since 1939 it has suffered considerably from bombs and in other ways; but it is surely to the national advantage to have a big and properly planned holiday town at Camber that will cater adequately for large numbers, rather than to allow the small but painful eyesores that spoil Winchelsea and Pett Level.

There is another and serious threat to our coast deriving from war-time uses. During the war many coastal areas had to be taken over by the Government Services for some specific purpose, but it would be little short of a national disaster if they were not handed back. The tank range which was

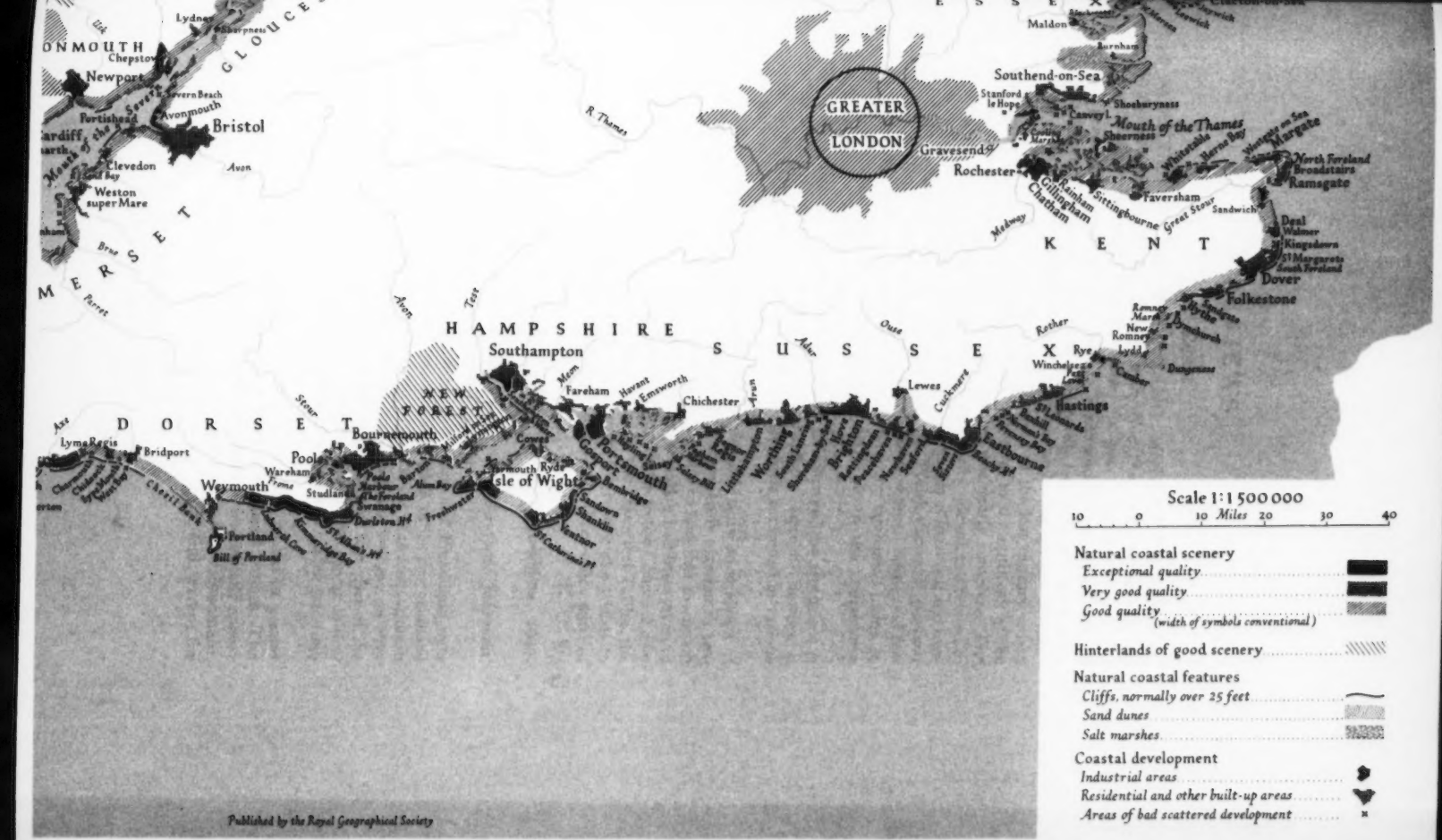
built behind Lulworth in Dorset has expanded far to the east and put out of bounds to the public for the time being some of the finest and most interesting parts of the Dorset coast between Kimmeridge and Lulworth. The beautiful limestone cliffs and upland between Stackpole and Linney Head in the Tenby Peninsula likewise are now as a rule unapproachable. The fine dunes on the Cumberland coast near Drigg, Pendine and Laugharne Burrows in Carmarthenshire, the South Haven Peninsula near Studland in Dorset, part of Ross Links in Northumberland, and Scolt Head Island in Norfolk are all, regrettably, prohibited areas. It is clear of course that space is limited in these islands, but there are plenty of open areas with less claims for preservation than those mentioned above. Once again it is the national view that is all important. It can be argued that a place like Scolt Head Island is not popular

in the sense that other parts of the Norfolk coast attract visitors. But Scolt and other places are essential open areas visited in the course of a year by a surprising number of people who want unspoiled sea coast. Moreover many of these areas are of great scientific interest. Unless the coast is visualized as a whole it is only too easy to say that such and such a particular area does not matter: if the total of these areas be reckoned and proper allowance made for the recreational and scientific value, a very different assessment of value emerges.

Many people dislike the word planning and fear that in practice it may disguise some form of prohibition. This view should be dispelled. As far as the coast is concerned, if indiscriminate building were to continue as in pre-war days most of it would be ruined. Having seen the whole coast of England and Wales I cannot emphasize too strongly that if we as a nation wish to preserve one of our finest heritages for the good of the people as a whole, we must act now and act vigorously on a national scale.

The Isles of Scilly

The map gives in black and white a general assessment of the Isles of Scilly. For the most part their great natural beauty is unspoiled, and all the coastal scenery can be classed as of exceptional quality, though here and there an unsightly building shows how easily it could be spoiled. The conventions used on the map are similar to those on the general map of England and Wales, but modified a little to accord with local conditions and difference of scale.


GREATER
LONDON
Scale 1:1 500 000
10 0 10 Miles 20 30 40
Natural coastal scenery
Exceptional quality
Very good quality
Good quality
(width of symbols conventional)
Hinterlands of good scenery
Natural coastal features
Cliffs, normally over 25 feet
Sand dunes
Salt marshes
Coastal development
Industrial areas
Residential and other built-up areas
Areas of bad scattered development
Published by the Royal Geographical Society

REVIEWS

EUROPE

THE AGRICULTURE OF WALES AND MONMOUTHSHIRE. By A. W. ASHBY and I. L. EVANS. *Aberystwyth: Hon. Soc. of Cymmrodorion and Univ. of Wales Press*, 1944. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 300 *pages; diagrams.* 15*s*

This book presents a survey of agriculture in Wales and Monmouthshire, with a detailed analysis of the trends of change between the two wars of this century. The authors, making very full use of official statistics and other sources of information, trace the changes from subsistence farming in the last century, when there was nearly as much arable as grassland in Wales, to the outbreak of the late war when the change to production for market was nearly complete. The concurrent increase in the livestock on farms is analysed in detail and related to changes in world markets and in national dietary. The sales of livestock and livestock products accounted for 95 per cent. of the Welsh farmers' pre-war receipts. The system of farming in general suits a land of small farms and few farm workers, but it seems that there are perhaps too many very small farms, in spite of the advantages which Welsh farmers derive from the cooperative organizations which they have built up.

With the exception of a chapter entitled Regional Survey, the treatment is national rather than regional and no maps are included. There are however a number of graphs which vividly present the essential facts contained in various statistical tables.

The volume provides a summary and analysis valuable alike to students of agriculture, economics, and geography. It brings conveniently together in two statistical appendices various tables, but the reader tends to find that too much is relegated to appendices, and wishes that more information had been given in the relevant chapters. There is one appendix giving Notes to the Chapters, two giving Statistical Tables, and another giving Notes on the Statistical Tables, the whole comprising more than 40 per cent. of the text: the reader who wishes to elucidate some point in the text has frequently to refer to three other parts of the book.

E. C. W.

RADNOR: Old and New. By W. H. HOWSE. *Hereford: Jakemans*, 1944. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 54 *pages; illustrations*

PRESTEIGNE: Past and Present. By W. H. HOWSE. *Hereford: Jakemans*, 1945. $9 \times 5\frac{1}{2}$ *inches;* 141 *pages; illustrations and plan*

These two topographical and historical guides to Radnor and Presteigne by a local resident were published within a few months of each other by Jakemans of Hereford. They are the product of a considerable amount of investigation in the field and of research into local records. In particular the volume on Presteigne is a real contribution to the history and geography of this part of the Welsh March. One can regret that they do not contain more topographical material, due in part no doubt to the difficulties of field-work under war-time conditions.

The value of these guides is that they preserve lore and record in greater detail than is possible in county histories or more specialized studies. The difficulty about them is that they have a mainly local appeal, and usually appear in very limited editions which disappear almost as quickly as the lore they contain. Unfortunately both these little books are already out of print, and, except for

those which have found their way into libraries, will soon be lost to the public. If the author can be persuaded to republish he could with advantage add material on tracks, roads, and channels of communication which a local resident can obtain from the memories of living people.

One of the most interesting features of the two volumes is a note and glossary on local dialect which is still rich in rare words and gay phrases.

The censorious reviewer might pass some comment on the production of the books, but none is really called for in view of the circumstances in which they were published. The author and publisher deserve their successful sales, and are urged to reserve for libraries and places of study a large proportion of their future output. R. OF R.

ESPAÑA: El País Y Los Habitantes. By L. MARTIN ESCHEVERRIA. *Mexico: D.F. Editorial Atlante, S.A.*, 1940. (*Oxford: Dolphin Press*). 9×6 *inches;* 488 *pages; illustrations, diagrams, and maps.* 30*s*

This large volume represents the expansion to handbook form of the little book published by the same author in the *Labor* series in 1928 as Part 1 of his "Geografía de España" (*Geogr. J.* 73 (1929) 164).

Most of the expansion is taken up by a much more detailed treatment of the chapter headings, which range over the whole field of geography, physical and human. The flowing narrative style makes easy reading, and some of the descriptive passages are charming. But it is rich browsing which is now provided, and the earlier book with its crisper statements will still be of use.

Elaborate bibliographical notes, appended to the chapters and amounting in each case to a history of the development of the relevant branch of Spanish studies, account for the rest of the expansion. Not very many of the specific references to literature can be followed up by the general reader, who gets few practical suggestions for the extension of his reading. Some of the omissions are surprising: the chapter on Towns and Cities has, for example, no reference to Jürgens' 'Spanische Städte,' and the introductory chapter, with its notes on historical geography, none to Schulten and Bosch Gimpera's 'Fontes Hispaniae Antiquae,' or to Alemany's summarized accounts of the geography of the Iberian Peninsula in the classical and Arab writers and in the Christian writers from Isidore of Seville onwards. It is not very kind to mention the 'Ora Maritima' of Avienus, the 'Cronica' of Rasis, and the Geography of El Edrisi, without a hint of where text, translation, or summary is to be found. Some people would think Abulfeda worthy of mention too, but the author passes him over in silence.

Even to the serious student the author is not invariably kind. In the discussion on tectonic problems, which appears in the bibliographical note to the chapter on The Relief and its Forms, much less than justice is done to the doctrine expounded by the Stille school. With reference to Andalusia, where the burning questions are first, whether or not there is a Guadalquivir fault, and second, whether autochthony or large-scale nappe movements prevail in the Andalusian chains, there is no mention of the important paper by Brinkmann and Gallwitz in the Stille series, dated 1933, and of the light it throws on the complexity of the Sierra Morena, or of Sermet's extraordinarily interesting paper on the Southern Alpujarra, published in the 'Boletín' of the Spanish Natural History Society in 1934, in which a purely morphological line of argument leads to the major tectonic conclusion, "C'est l'autochtonie qui s'impose ici." These omissions and others arouse a strong suspicion that the author's sources diminish rapidly after about 1932, which is hardly good enough for a book published in 1940.

The chapters on Structure and Relief are however the least satisfactory of a book which people specially interested in Spain would do well to regard as indispensable. R. A.

ASIA

EARLY MAN AND PLEISTOCENE STRATIGRAPHY IN SOUTHERN and Eastern Asia. By H. L. Movius, Jr. (Papers of the Peabody Museum, Harvard University, vol. 19, No. 3.) *Cambridge, Mass.: Peabody Museum*, 1944. x+126 *pages; illustrations, diagrams, and sketch-maps*

In this important memoir Dr. Movius has collected together the general results of investigations associated particularly with the work of the 1937–38 American South-east Asiatic Expedition. The areas covered are North-west India, Upper Burma, Northern China, and Java.

In the Summary and Conclusions the author finds it possible to correlate the sequence in each of these areas and has divided the Pleistocene into a Lower (Villafranchian), Middle, and Upper. The Lower Pleistocene includes the First Glacial and First Interglacial of Kashmir which are associated respectively with the Pluvial (cool and temperate) deposits of the Tatrot Zone in the Punjab, and with the warm, temperate Interpluvial Pinjor Zone. The Upper Irrawaddian of Burma is allocated to the Lower Pleistocene. The Middle Pleistocene includes the Second Glacial and Second Interglacial of Kashmir and is marked in the Punjab by the Boulder Conglomerate and in Burma by the Lateritic Gravel which has yielded human implements of the previously described Anyathian culture. In Java *Pithecanthropus erectus* is allotted to this horizon, while *Sinanthropus pekinensis* (Pekin man) is regarded as upper Middle Pleistocene. The Upper Pleistocene includes the Third Glacial, the Third Interglacial, and the Fourth Glacial of Kashmir, with corresponding Pluvial and Interpluvial periods in the Punjab the deposits of which yield late Acheulean and late Soan implements. In Burma the main Irrawaddian Terrace (T_3) and the later Pagan Silt are correlated with this horizon and in Java the fossil remains of *Homo wadjakensis* and *Homo soloensis*.

In a previous review in the *Journal* (102 (1943) 140) it was suggested that the sequence of the terraces of the River Irrawaddy in Burma is not as clear as de Terra suggested and obviously much work remains to be done in what was until very recently a virgin field. It is interesting however to record the growing bulk of evidence in favour of four Glacial periods in Asia, which in due course may be correlated with the four famous Alpine glaciations of Europe. On the other hand the Asiatic cultures—the Anyathian of Burma, Soan of north-west India, Patjitanian of Java, and Choukoutienian of north China—though all of Middle Pleistocene age are quite different from those of comparable age in Europe. The characteristic implements are choppers and hand-adzes; hand axes are absent. L. D. S.

NORTH AMERICA

THE ALEUTIAN ISLANDS: their people and natural history. By H. B. Collins, Jr., A. H. Clark, and W. H. Walker. (War Background Study No. 21.) *Washington, D.C.: Smithsonian Institution*, 1945. 9×6 *inches;* iv+132 *pages; illustrations and folding-map*

'The Aleutian Islands,' will be welcomed not only by the garrisons of these outposts of United States territory in the North Pacific for whom the book is intended, but also by many others. It gives a good deal of valuable information about a part of the world still singularly little known, and about

which new information is still coming to hand, such as the recent discovery, by United States airmen, of a giant crater on the island of Umnak.

The book is divided into three sections. In the first, Dr. Henry Collins outlines briefly the geography of the islands, with their smoking volcanoes and fog-bound shores, and the life-history (as far as it is known) of their interesting inhabitants the Aleuts, a race now nearly extinct but formerly numerous, whose language and customs are distinct from their only known relatives, the Eskimos. From the excavations of ancient graves and old village sites on the islands by the late Dr. Aleš Hrdlička, it would appear that the modern Aleuts resemble the Tungus and other Siberian tribes more closely than they resemble the Eskimos or North American Indians. The skeletons taken from lower levels, however, show that the occupants of the islands, probably some two thousand years ago, were of a "generalized Eskimo" type. The significance of this interesting difference awaits further research. It may be, as Dr. Collins suggests, that the islands were colonized from the Alaskan side by early Eskimoid tribes who crossed the Bering Strait from Asia some time after the glacial period. These people may have slowly penetrated the islands from west to east, but this theory scarcely explains Dr. Hrdlička's discoveries of more recent Asiatic types, and if there is at present "no geological or other evidence" of the existence of a former "land-bridge" between Kamchatka and the Near Islands of the Aleutian group (Attu, Agattu, and Kiska) what is then the significance of the distinct Kamchatkan flora and vegetation found on these islands?

Dr. Egbert Walker has based his interesting section on plant life on Dr. Eric Hultén's standard 'Flora of the Aleutian Islands,' published in 1937, and was aided by a team of five soldiers and airmen under Lieut. George Van Schaack of the United States Navy. This group of wartime scientists has continued the work in a paper "Flowers of Island X" (*i.e.* Attu Island), just issued by the U.S. Navy Welfare and Recreation Department), which adds considerably to some of Dr. Hultén's findings and modifies others.

The section on animal and bird life by Dr. Austin H. Clark is of exceptional interest, for Aleutian waters teem with an immense variety of seabirds and fishes (including the interesting Attu or Atka mackerel, a unique species) as well as several sea mammals. Amchitka Island is the last sanctuary of the sea-otter, almost exterminated by the Russian traders of the eighteenth and early nineteenth centuries.

The illustrations are excellent, and the keys to plant and bird life in the appendices should do much to relieve the monotony of island life for American soldiers, sailors, and airmen fortunate enough to be stationed in a part of the world where so much still remains unexplored and where, in the region of such subjects as marine algae, fungi, or insect life, "almost anyone" (to quote Dr. Egbert Walker) "can make a valuable contribution to science provided the specimens are properly labelled." I. W. H.

AFRICA

A BOTANIST IN SOUTHERN AFRICA. By JOHN HUTCHINSON. *London: P. R. Gawthorn*, 1945. 10×6 *inches;* xii+686 *pages; illustrations, diagrams, and maps.* 45*s*

This is a new and original kind of botanical book. The author has written it in the form of a diary. At each of his collecting grounds he gives a list of the species found with brief descriptions and usually drawings of the more interesting. Matters of botanical interest, such as the range of certain species and Wegener's displacement theory are discussed under the species which serve to

illustrate them. A map on p. 19 shows the major botanical regions of Africa, while those of South Africa are dealt with on pp. 537–553, and there are small inset maps to show the species common to Africa and America (pp. 12–13). At the end of the book there is a review of South African botanical literature and a sketch of the history of botanical exploration, which frequently went hand in hand with geographical exploration. The photographs of vegetation, mainly by Dr. I. B. Pole Evans, are equal to the best that have been published. They include a splendid *Welwitschia* (opposite p. 160).

The author does not refer to the influence and example of H. A. van Rheede tot Drakenstein in his account of the early Dutch botanists at the Cape. Rheede had been Governor of Malabar, where he was responsible for the magnificent twelve volumes of the 'Hortus Malabaricus,' and after spending the years 1676–1684 in Holland he was appointed Commissioner-General of the Indies, with power to appoint or displace governors and admirals, to proclaim new laws, and to enter into treaties with native rulers. Rheede arrived at Table Bay on 19 April 1685 and remained till July 16 of the same year. He wished to follow the 'Hortus Malabaricus' with a 'Hortus Africus,' and engaged as an assistant a young doctor from Breslau, named Hendrik Claudius, who had already prepared two large folio volumes of paintings and plants, and was engaged on a third at the time of Père Tachard's visit. Since 1681 Claudius had been collecting for Andreas Cleyer, who paid him "drie swaere schellingen" for each mounted specimen. Rheede stayed at Groot Constantia with the Governor, Simon van der Stell, who named the district of Drakenstein after him. Directly after the departure of Rheede, van der Stell left for Namaqualand on an exploring expedition. Some drawings of plants collected on this expedition were made by Père Tachard, who published them in his 'Second voyage' (1689).

For the botanist travelling in South Africa, Dr. Hutchinson's book should prove as valuable a companion as is Dr. Lloyd Praeger's 'Tourists' Flora' to botanists in Western Ireland. The line-drawings should make the identification of the species easy. A. H. G. A.

AUSTRALASIA AND THE PACIFIC

SOIL EROSION IN NEW ZEALAND: a geographic reconnaissance. By KENNETH B. CUMBERLAND. *Wellington: Soil Conservation and Rivers Control Council*, 1944. 9×5½ *inches; 227 pages; illustrations and maps*

Among many books on soil erosion, this is one of especial interest to geographers, because the author is himself a professional geographer and the geographical approach to New Zealand problems is marked throughout. This finds expression in the division of the country into a number of clearly-defined natural regions having different erosion problems. Such an approach is clearly successful, though in studying the prevention and cure of erosion, that is, soil conservation, experience in other fields such as agriculture, forestry, and engineering is also desirable. The author does not attempt to go far in this direction, except to indicate some general methods that might be adopted, again on a regional basis.

It may surprise many to realize how serious a problem erosion is in New Zealand. Here is a country which has, on the whole, a humid rather than an arid climate, with relatively little land under arable cultivation, but much under grass. Grassing-down is often recommended as a cure for the erosion of arable land: yet New Zealand's grasslands are eroded. The explanation lies partly in over-grazing and bad management of hill pastures, but chiefly in the steep slopes of much of the country which has been put down to grass. So steep are

they that landslips occur even under the original forest vegetation, and once this has been removed the landslips multiply. As a consequence, landslip erosion, which is relatively uncommon in most parts of the world where erosion has been studied, is the dominating form in New Zealand. In some parts of the country it has become so grave a problem that hundreds of thousands of acres which were once cleared and settled have now been abandoned *en masse*: the settlers have walked off, road maintenance has been abandoned, and the land is reverting to second-growth and forest. This will cure the erosion, but it would have been better if the land had been deliberately reforested with useful timber trees. Students of landslips and allied phenomena will find much of interest in the book, especially in the photographs.

Many other types of erosion are described, some of them new. The familiar sheet erosion and gullying of cultivated sloping land, and even some instances of man-made deserts in the dry interior of the South Island, are recorded, but such phenomena, because they are more localized, are a less serious menace than landslip erosion.

In a series of appendices the author briefly describes the geological and surface characteristics, climate, vegetation, and soils of New Zealand in relation to erosion.

Special mention should be made of the dramatic photographs with which the book is illustrated. They show more clearly than words the seriousness of the different types of erosion, though it is possible that they may create an exaggerated impression of the total extent of erosion in New Zealand.

The photographs help to bring out a point to which the reviewer would like to draw the attention of geomorphologists, namely, that provided allowance is made for differences in causative factors, the accelerated erosion caused by human misuse of land may often be taken as a working model, on an abbreviated time-scale, of what happens during geological or normal erosion.

The production of the book is excellent, despite the war-time difficulties of book production. H. L. R.

THE PACIFIC WORLD. Edited by FAIRFIELD OSBORN. *London: George Allen and Unwin*, 1945. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 218 pages; illustrations and sketch-maps. 12s 6d*

It is not clear when this book was first published in the United States, but the British edition, published in 1945, bears evidence of hurried production. It is apparently the introductory volume of a series initiated by the American Committee for International Wild Life Protection, in the belief "that literature regarding the animal life of the Pacific Islands would encourage its conservation." The present volume, compiled "by 28 men of nine institutions," contains a good deal of useful information, but it lacks coordination.

A brief introduction by William Beebe commends the book to the service man in the Pacific. To one who was recently a service man in the Pacific, this introduction has a patronizing air which prejudices one against the book from the start. It is followed by eleven chapters, constituting the first half of the book, which deal with the physical background, discovery and exploration, the flora and fauna, and the races of man. These vary in quality, but one finds in most of them a well-chosen summary of the main features of importance and interest.

The second half of the book is devoted to regions which cover the Western Pacific and the Netherlands East Indies, but not the Eastern Pacific nor China. This is perhaps legitimate, but it might have been advisable to explain in the introduction that, for the purposes of this volume, the "Pacific World" em-

braces the war-time commands of Admiral Nimitz and General MacArthur, with the sole curious addition of Sumatra from Admiral Mountbatten's command. Each chapter is a quite readable account of the main features of interest in the region.

Two kinds of illustration are included: some rather crude black and white maps, and some coloured diagrams, which are in the main more pretentious than useful.

In making one final criticism, namely of the peculiar typographical eccentricities which mar a number of the pages (*e.g.* pp. 116, 131, and 157), one may still say that the book makes a very readable handbook. F. H. W. G.

PHYSICAL GEOGRAPHY

METHODS IN CLIMATOLOGY. By VICTOR A. CONRAD. *Cambridge, Mass.: Harvard Univ. Press*, 1944 (*London: Oxford Univ. Press*). 9×6 *inches; xx+228 pages; sketch-maps and diagrams.* 22*s* 6*d*

The results of many years' work in Vienna by the author and his associates are given in this volume, thereby making accessible the essential part of many German articles and monographs.

It was the author's intention to write a work complementary to existing treatises on climatology. "For the most part, climatographies have been written by geographers. Therefore, geographical methods are kept to the forefront, and specifically climatological methods are not so much used. It would be satisfying if this book offered a bridge connecting the two realms. . . . The student in geography has perhaps sufficient knowledge of climatology, but he does not know how to deal with the original data of observations. . . . This book should make the student acquainted with a number of methods of mathematical statistics and theory of probability applicable at once to climatological problems."

Geographers are likely to be impressed by the demonstration of the need for critical and rigorous scrutiny of climatological series and also by the variety of statistical methods developed. The first part of the book is a review of the statistical characteristics of climatological elements; the second part gives a discussion of the analysis and representation of the temporal incidence of elements, notably temperature, wind, and rainfall; and in the third part, the exposition of the means of analysing spatial distribution of elements, are well conceived and presented. All employing climatological values for the purposes of geographical research will need Dr. Conrad's book as a work of instruction and reference.

J. H. G. L.

DELTAIC FORMATIONS, with special reference to the hydrographic processes of the Ganges and the Brahmaputra. By C. STRICKLAND. *London: Longmans Green*, 1940. $8\frac{1}{2}\times5\frac{1}{2}$ *inches; x+158 pages; illustrations, sketch-maps, and diagrams*

This is a difficult book to assess, largely because the writer is by profession a doctor and not a physiographer, but also because of the manner in which he writes. He naturally tends to use medical similes, some of which are very appropriate. On the other hand his style is at times difficult.

The subject-matter of the book concerns mainly the Ganges delta. A great deal of interesting information is presented, together with a detailed analysis of many characteristics of channels and their vagaries and the processes of silting-up. Local nomenclature is also explained. A few of the diagrams would have been more useful if the vertical scale had not been grossly exaggerated: Fig 1, for instance, has a very unreal appearance. Many of the illustrations are apposite, but it is unfortunate that they have been poorly reproduced.

Students of physical geography will find matter for thought in this volume, but it is difficult to avoid the impression that the material could have been presented far more convincingly. J. A. S.

CARTOGRAPHY

ASTRO-NAVIGATION TABLES FOR THE COMMON TANGENT Method. By E. E. BENEST and E. M. TIMBERLAKE. *Cambridge: W. Heffer*, 1945. 11 × 8½ *inches; 107 pages; diagrams and tables.* 7s 6d

These tables are primarily intended for the use of navigators by sea and air. For their purposes no interpolation in the tables is necessary, the results being obtainable to 1′ arc. For more accurate work, such as that of the traveller by land, interpolation will permit position finding to 0·1′ arc.

The Marc St. Hilaire method has become almost a standard procedure for plotting position lines by azimuth and intercept, especially when the work is done on a Mercator Chart. Numerous sets of tables have appeared to facilitate such work. A difficulty arises however when operating in high latitudes, only partly due to the impracticability of the Mercator in those parts. Originally proposed by Aquino, the common tangent method of plotting overcomes all those difficulties. It is applicable to Stereographic and Polar Equidistant projections, or any conformal chart, as well as having much to recommend it in all latitudes, and on the Mercator.

Instead of plotting an azimuth line, in which the azimuth has to be computed or extracted from an alt-azimuth table, and then plotting a position line perpendicular to it, both of which operations require the use of a protractor with its attendant inaccuracies, the common tangent method demands only the drawing of two circles to which the position line is the common tangent. Those two circles have centres at assumed positions 1° of latitude apart, and radii equal to the differences of observed and computed altitudes of the sun or star. The computational work is reduced to entries into two tables and three simple additions, or subtractions, as the case may be.

These tables are simpler to use than the usual navigation tables of the alt-azimuth type. They are intended for use in conjunction with the British Air Almanac, or the American Nautical Almanac, being based on Greenwich Hour Angles in arc in place of Right Ascensions in time, which has much in its favour for rapid working of navigational problems.

There is an admirably clear step-by-step explanation of the use of the tables, with a tabular form of computation. A series of worked examples shows the several types of cases which may arise, it also illustrates the three degrees of accuracy which may be obtained. For ultra rapid working in the air, the last figure in the tables is dropped. For marine navigation all the figures in the tables are used, and for land work interpolation by first differences is desirable. For the mathematically inclined reader an explanation of the derivation of the tables is given, with clear diagrams of the quantities involved on the celestial sphere.

An additional table is provided, with explanatory text, to facilitate navigation by position lines in high altitudes, when the Mercator Chart cannot be used. The time interval between observations of two or more stars to obtain position lines, which when plotted will intersect to give a fix, requires that the earlier of these position lines be transferred, to allow for the change in position of the observer in aircraft or ship during the interval between observations, the so-called "distance run." When working on a conformal chart with converging meridians a correction has to be applied to the original bearing of the position

line when it is transferred. The table gives a coefficient which when multiplied by the distance run gives the required correction.

The explanation is set up in type, but the tables themselves are facsimiles of typewritten sheets, and it is inevitable that imperfections in the typing have been reproduced. A further disadvantage of this method of reproduction is seen in the size of the publication, a limp paper-covered book which when open occupies 17 inches × 11 inches, an inconveniently large size for use on the plotting table of an aircraft, or indeed in the polar traveller's tent. O. H. C.

GENERAL

CRUISING YACHTS: design and performance. By T. HARRISON BUTLER. *London: Robert Ross*, 1945. 8½ × 5½ *inches; 144 pages; illustrations and diagrams.* 15*s*

The late Dr. Harrison Butler has been known for many years as an outstanding amateur designer of small cruising yachts, and as an ardent exponent of the metacentric theory of hull balance.

In this small book he sets out to describe how he goes to work on a design with the object of teaching an ordinary sailing man to put his ideas of a boat on paper. In the first few chapters there is some excellent advice on how a design should be begun. He starts with the first conception of the lines of a boat made lying in his bath, shows how a preliminary sketch should be made, then goes on to the proper drawing, with much wisdom about ink and paper, clearing up of messes, drawing pens, curves, and splines.

The author's method is to design entirely by eye. He says he never thinks of any calculations until he has his faired-up drawing lying before him. He thus keeps mathematics down to the simplest possible. What calculations are necessary he shows us how to do in full detail. The mysteries of Engineer Rear-Admiral Turner's metacentric theory are difficult to follow, but Dr. Butler shows how a balanced hull can be designed by the method of cutting out paper sections and balancing them on a razor-edge. By a careful analysis, such as he describes, we can obtain perfect hull balance. That is to say the lines of the bow and stern will be so balanced that the vessel will run straight on all points of sailing without the heavy use of the helm and the griping which is so familiar in most cruisers and fishing boats.

A number of the author's designs are included, and many of them have been built and sailed all over the world, giving great satisfaction to their owners. It would seem therefore that for small sea-going cruisers the metacentric design is of great value. Especially valuable is the characteristic of the vessel being able to "sail herself." Most men who go to sea in small cruisers would give up much in other advantages to attain this virtue. In fact for long passages short-handed it is an essential. The book includes valuable work on design of rigging, lay out, engine installation, and ballasting. There is a complete description of making the metacentric analysis with the aid of a planimeter and for finding the centre of gravity so that the ballast keel can be put in the exact right position. A chapter of "Odds and ends" followed by a selection of the author's designs completes a very valuable and original piece of work on the art of boat designing, which will be of lasting help to the amateur, and provide much thought for the professional. If Dr. Butler's advice is followed cruising yachts will be better built, sail more easily, and have fewer mistakes in them than they have had before. With the aid of this book any one who is prepared to take pains with accurate drawing should be able to design his own boat. A. C.

ADDITIONS TO THE LIBRARY

EUROPE

THE GEOLOGICAL RESULTS OF THE SEARCH FOR OILFIELDS IN GREAT BRITAIN

By G. M. Lees and A. H. Taitt. (*Quart. J. Geol. Soc.* 101 (1946) 255–317; illustrations and maps)

THE NATIONAL TRUST: a record of fifty years' achievement

Ed. by J. Lees-Milne. 8½×5½. xii+132 pp. Illustrations. *London: Batsford*, 1945

THE DYNAMICS OF FAULTING AND DYKE FORMATION WITH APPLICATIONS TO BRITAIN

By E. M. Anderson. 9×5½. xii+192 pp. Diagrams and sketch-maps. *Edinburgh: Oliver and Boyd*, 1942. 15*s*

REVOLUTION IN AGRICULTURE

By G. A. Holmes. 7½×6. 128 pp. *London: Todd Publ. Co.*, 1946

The author is a New Zealand agricultural expert who came to England to assist in the war-time food production campaign.

THE BLACK FEN

By G. H. Bates. (*Journ. R. Agric. Soc.* 101 (1945) 76–84)

Farming in the peaty fens centering on the Isle of Ely

THE FLORA OF UIG (Lewis); a botanical exploration

By M. S. Campbell. 8½×5½. 64 pp. Map and illustrations. *Arbroath: Buncle*, 1945. 10*s* 6*d*

THE GRAIGUENAMANAGH BASIN [Kilkenny]

By T. W. Freeman. (*Bull. Geogr. Soc. Ireland*, 1 (1946) 61–76; sketch-maps)

THE DEVELOPMENT OF MODERN FRANCE, 1870–1939

By D. W. Brogan. 6th impr. 9½×6. x+744 pp. *London: Hamish Hamilton*, 1945

LA BOURGOGNE. (Collection A. Colin: section de géogr.)

By Georges Chabot. 2nd ed. 6½×4½. 224 pp. Sketch-maps. *Paris: A. Colin*, 1945. *Fr.*60

THE RUHR COAL-MINING DISTRICT

By C. D. Harris (*Geogr. Rev.* 36 (1946) 194–221; sketch-maps and diagrams)

POLITICAL-ADMINISTRATIVE DIVISIONS OF THE U.S.S.R., 1945

By T. Shabad. (*Geogr. Rev.* 36 (1946) 303–11)

ASIA

ASIA'S LANDS AND PEOPLES

By George B. Cressey. 9½×7. xii+608 pp. Maps and illustrations. *New York: McGraw-Hill*, 1944

A regional geography of Asia, based on 22 "provinces" and 94 regions. The author has managed to cover many topics, including history, ethnography, politics, and international relationships. Particular attention is given to India, China, Japan, and the U.S.S.R.

BEYOND THE BURMA ROAD

By A. H. Brodrick. 8½×5½. 112 pp. Illustrations and sketch-maps. *London: Hutchinson*, 1944. 16*s*

THE OLD BURMA ROAD; a journey on foot and muleback

By Neville Bradley. 8½×5½. viii+138 pp. Illustrations. *London: Heinemann*, 1945. 9*s* 6*d*

THE PHYSIOGRAPHY AND IGNEOUS GEOLOGY OF HONG KONG AND THE NEW TERRITORIES

By M. Y. Williams and others. (*Trans. R. Soc. Canada, Ser.* iii, 39 (1945) *sect.* iv, 91–119)

THREE CARAVAN CITIES: Petra, Jerash, Baalbek, and St. Catherine's Monastery, Sinai

By Paul Gotch. 8½×5½. xvi+124 pp. Illustrations and sketch-maps. *Alexandria: Whitehead Morris*, 1945. 10*s*

TWIN RIVERS; a brief history of Iraq from the earliest times to the present day

By Seton Lloyd. 8½×5½. vi+230 pp. Illustrations. *Bombay: Oxford Univ. Press*, 1943

A SHORT ECONOMIC HISTORY OF MODERN JAPAN, 1867–1937

By G. C. Allen. 8½×6. 200 pp. *London: Allen and Unwin*, 1946. 10*s* 6*d*

MODERN KOREA

By Andrew J. Grajdanzev. 9×6. x+330 pp. Maps. *New York: Inst. of Pacific Relations*, 1944. 20*s*

"There is probably no other country in the world with so large a population and so strategic a position that has received so little attention in Western literature." The author's aim is to present the facts of the development under Japanese rule as far as they can be extracted from Japanese reports and statistics.

THE PHILIPPINES
(Special Number of *Far Eastern Quarterly*, vol. 4, No. 2, Wisconsin, 1945)

AFRICA

THE CADASTRAL SURVEY OF EGYPT
By Sir Ernest Dowson and V. L. O. Sheppard (*Empire Survey Rev.* 8 (1945) 82–93; 122–33; 162–75)

SURVEY OF THE ANGLO-EGYPTIAN SUDAN 1898–1944
By K. D. D. Henderson. 7×5. 60 pp. Illustrations. *London: Longmans, Green*, 1946. 1*s*

A timely and instructive outline of political, social, and economic development in the Sudan.

GEOLOGY AND HYDROLOGY OF THE COASTAL AREA EAST OF THE AKWAPIM RANGE [GOLD COAST]
By N. R. Junner and D. A. Bates. (*Gold Coast Geol. Surv., Mem.* 7 (1945) 24 pp.; map)

ELEMENTOS PARA O ESTUDO DAS CONDIÇÕES CLIMATICAS DE MOÇAMBIQUE
By José de Oliveira Boléo. (*Moçambique*, No. 44 (1945) 81–128. Sketch-maps and diagrams)

LA COLONISATION DE LA BOUCLE DU NIGER
By Jean Gabus. (*Bull. Soc. Neuchatel. géogr.* 51 (1945) 1–61; sketch-maps and illustrations)

LIVINGSTONE'S LAST JOURNEY
By Sir Reginald Coupland. 8½×5½. 272 pp. Illustrations and sketch-maps. *London: Collins*, 1945. 12*s* 6*d*

A detailed account of Livingstone's last years, 1866–74, making use of material in the Kirk and Waller papers. Special attention is paid to his relations with H. M. Stanley and John Kirk, and to the controversies in which they became involved. The whole forms a sympathetic and impartial study of Livingstone's character and achievements in the face of exceptional difficulties and constant ill health.

SIR RICHARD BURTON AND THE NILE SOURCES
By J. N. L. Baker. (From *English Hist. Rev.* Jan. 1944, pp. 49–61)

Traces the fundamental causes of the controversy which embittered the course of Central African exploration.

THE MATABELE JOURNALS OF ROBERT MOFFAT, 1829–1860. (Govt. Archives S. Rhodesia; Oppenheimer Ser., No. 1, vols. 1 and 2)
Ed. by J. P. R. Wallis. 10×6½. xvi+382, 296. Portraits and maps. *London: Chatto and Windus*, 1945. 30*s each vol.*

These records of Moffat's journeys are of first importance for the expansion northwards to the Zambezi. Though the missionary interest predominates, there is much information on Matabele life and history, and references to work of his son-in-law, David Livingstone.

AMERICA

FLUORINE IN UNITED STATES WATER SUPPLIES: pilot project for the Atlas of Diseases
By A. von Burkalow. (*Geogr. Rev.* 36 (1946) 177–93; maps)

CLIMATE OF INDIANA
By S. S. Visher. 10×7. 512 pp. Diagrams and sketch-maps. *Bloomington, Ind.: Indiana Univ.*, 1944. $4.00

CANADIAN RESTORATION
By E. Newton-White. 7½×5½. x + 228. *Toronto: Ryerson Press* (1944)

LETTERS OF JOHN MCLOUGHLIN FROM FORT VANCOUVER TO THE GOVERNOR AND COMMITTEE. 3rd series. 1844–46
Ed. by W. E. Rich. (*Publns. Champlain Soc.*, H.B.C. ser., 7.) 9½×6½. lxiv+342 pp. *Toronto*, 1944

EVOLUTION OF MODERN LATIN AMERICA
By R. A. Humphreys. 7½×5. 196 pp. *Oxford: Clarendon Press*, 1946. 7*s* 6*d*

INDUSTRY IN LATIN AMERICA
By George Wythe. 9×6. x+372 pp. *New York: Columbia Univ. Press*, 1945. 24*s*

The author has had long experience of South America as a U.S. commercial attaché. After detailing all the industrial undertakings now established, he examines the future prospects of industrialization, emphasizing the need for a sound industrial evolution, "subordinate to, but supplementing and supporting the returns derived from mining, agriculture, and live stock."

BOSQUEJO FISIOGEOGRAFICO DE TUCUMÁN
By G. Rohmeder. (*Monogr. Inst. Estudios Geogr. Tucumán*, 6 (1945) 44 pp.; maps)

FUNDAMENTOS GEOGRÁFICOS DA MINERAÇÃO BRASILEIRA
By S. Fróis Abreu. (*Rev. Brasil. Geogr.* 7 (1945) 3–136)

THROUGH UNKNOWN NICARAGUA
By Mervyn G. Palmer. 9×6. 150 pp. Illustrations. *London: Jarrolds*, 1945. 21*s*

PHYSICAL AND MATHEMATICAL

CRITIQUE ET GÉOLOGIE: contribution à l'histoire des sciences de la terre, 1882–1942. Vol. I

By Emm. de Margerie. 11×9. xx+659 pp. Illustrations and maps. *Paris: A. Colin*, 1943

Professor de Margerie is publishing numerous miscellaneous papers, systematically arranged, which he has gathered in the last sixty years. The collection includes correspondence with scientists, reviews of his own works, and reviews by him of important books. Much of this volume is concerned with the French edition of Suess' 'Antlitz der Erde'

AN ESTIMATE OF THE AGE OF THE EARTH

By Arthur Holmes. (*Nature*, 157 (1946) 680–84)

RESEARCH ON THE PAST CLIMATE AND CONTINENTAL DRIFT

By Ting Ying H. Ma. 3 parts. 10½×7½. 50, 126, 104 pp. Maps and diagrams. *Yungan, Fukien: priv. pr.*, 1943

Pt. I deals with the Ordovician period, pt. ii with the Silurian, and pt. iii with the Devonian

OCEAN WAVES AND SWELL

By G. E. R. Deacon. (*Occ. Papers. Challenger Soc.*, No. 1 (1946), pp. 12)

WEATHER AROUND THE WORLD

By I. R. Tannehill. 8×5. xii+200. Illustrations and diagrams. *Princeton: Univ. Press*, 1944 (Oxford U.P.). 16*s* 6*d*

ASTRO-NAVIGATION TABLES FOR THE COMMON TANGENT METHOD SPECIALLY DEVELOPED AND ARRANGED

By E. E. Benest and E. M. Timberlake. 11×8½. 108 pp. *Cambridge: Heffer*, 1945. 7*s* 6*d*

A CONTOUR DICTIONARY: a short text-book on contour reading with map exercises

By J. B. Goodson and J. A. Morris. 10×7½. 48 pp. Maps. *London: Harrap*, 1945. 3*s* 6*d*

ECONOMIC AND GENERAL

POPULATION AND PEACE IN THE PACIFIC

By Warren S. Thompson. 9×6. 398 pp. Maps. *Chicago: Univ. of Chicago (Cambridge U.P.)*, 1946

An examination of population growth in relation to natural resources in the region extending from Hawaii to India. The author concludes that emigration can afford no relief, though psychologically it may be important, that machine industry will be slow in developing, even if capital is available, and that the only solution is a timely redistribution of the world's resources, including undeveloped lands, under an international organization

THE EARTH AND THE STATE: a study of political geography

By Derwent Whittlesey. 8½×5½. xviii and 618 pp. Sketch-maps. *New York: Holt*, 1944. $4.00

NORTHERN LIMITS OF WHEAT PRODUCTION

By R. Newton. (*Trans. R. Soc. Canada* 39 (1945) sect. v, 1–20)

GUIDE DE L'ÉTUDIANT EN GÉOGRAPHIE

By A. Cholley. 7½×5. 232 pp. *Paris: Presses Universitaires*, 1942

The author summarizes clearly the current approach of the French school to geography and geographical method. He warns students against a tendency to become too concerned with historical developments in dealing with problems of human geography

CRISTÓBAL COLÓN Y EL DESCUBRIMIENTO DE AMERICA

By Antonio Ballesteros y Beretta. 2 vols. (Historia de América, vols. 4, 5.) 10×6½. x and 556; viii and 770 pp. Illustrations. *Barcelona—Buenos Aires: Salvat ed.*, 1945

MODERN EXPLORATION

By F. Kingdon Ward. 8×5½. 124 pp. *London: Jonathan Cape*, 1945. 6*s*

I PLANTED TREES

By R. St. Barbe Baker. 8×5½. 262 pp. Illustrations. *London: Lutterworth Press*, 1945. 10*s* 6*d*

THE MONTHLY RECORD

MEDALS AND AWARDS 1945–46

His Majesty the King has approved the award of the Royal Medals as follows: the *Founder's Medal* for 1945 to Dr. Charles Camsell, C.M.G., for his contributions to the geology and geography of the Canadian North and his work in advancing geographical science in the Dominion; the *Patron's Medal* for 1946 to Sub-Inspector Henry A. Larsen, R.C.M.P., for his achievement of the North West Passage in the *St. Roch* from west to east in 1940–42, and from east to west in one season in 1944; and the *Founder's Medal* for 1946 to Brigadier Edward A. Glennie, C.I.E., D.S.O., for his work on geodesy in India and his contributions to mapping in the Far East. The Council have awarded the *Victoria Medal* for 1946 to Professor H. J. Fleure, F.R.S., for his distinguished service in the advancement of geographical education and his valuable researches into the human aspects of geography; the *Murchison Grant* for 1945 to Lieutenant-Colonel W. E. Browne, M.B.E., for his work on geodetic survey, and in extending triangulation over long distances at sea; the *Murchison Grant* for 1946 to Lieutenant-Colonel C. A. Hart for his work on the application of radar to air survey; the *Back Grant* for 1946 to J. W. S. Marr for his work in connection with the *Discovery* investigations and his memoir on the South Orkney Islands; the *Gill Memorial* for 1945 to Commander K. E. Oom, O.B.E., R.A.N., for his surveys on the coast of New Guinea during 1942 and 1943, and for subsequent surveys as head of the Australian Hydrographic Department; and the *Gill Memorial* for 1946 to Wing-Commander D. C. McKinley, D.F.C., A.F.C., as organizer and leader of a series of flights to the North Magnetic and North Geographical Poles in May, 1945, in the Empire Air Navigation School aircraft *Aries*.

BIBLIOGRAPHIE GÉOGRAPHIQUE INTERNATIONALE

Copies of the *Bibliographie Géographique Internationale* for 1939 have been received at the Society for distribution in this country. By arrangement with the publishers the price is fixed to cover cost of production and distribution only, and for this volume is eleven shillings post free. The stock is limited, and orders should be sent to the Office of the Society as soon as possible.

A single volume to cover the years 1940–44 is now in preparation, and it is hoped that it will be published this year.

OCEANOGRAPHICAL WORK IN THE MEDITERRANEAN

We have received news that Professor Hans Pettersson, Director of the Oceanografiska Institutet at Göteborg, left Sweden at the beginning of April to carry out oceanographical research work in the Mediterranean. He will be assisted by Professor Weibull, who is an authority on the thickness of sediments. They have chosen Algiers for their main work as sufficiently great depths are available near the port, and return would be possible each night. If the experimental gear proves satisfactory down to such depths as 3000 metres, they hope to extend their researches to the greater depths off Malta, and possibly to visit Monaco. Towards the end of May Professor Pettersson intends to do some biological work on the trawling grounds west of Gibraltar before his return to Sweden in the middle of June. Professor Pettersson has accepted an invitation to lecture to the Society on this preliminary expedition in the autumn. Meanwhile, we hope to publish further interim notes on the progress of his researches.

THE 1/MILLION MAP OF HISPANIC AMERICA

The great cartographic undertaking of the American Geographical Society, the Map of Hispanic America on the scale of 1/Million conforming to the style of the International Map, has now been completed with the publication of the Bogotá sheet. This is a notable event in the advance of geography, and British geographers will wish to congratulate their American colleagues on this achievement. The one hundred and seven sheets cover an area of approximately 8,000,000 square miles, extending from the Mexican–United States border to Cape Horn, including the West Indies. No similar map is available for any comparable area of the earth's surface.

To the January number of the *Geographical Review* Mr. Raye R. Platt, who has been associated throughout with the compilation and production of the map, contributes an account of its genesis and development. Dr. Isaiah Bowman had experienced the need for a reliable map on an adequate scale for field work during his Andean expedition of 1913. When shortly afterwards he was appointed Director of the American Geographical Society, a scheme for research in Hispanic America was initiated which involved the collection and classification of the available geographical material, and it became clear that the compilation of a standard base map was of primary importance. The scale and style of the International Map were adopted with the assent of the Hispanic American countries, the sheets being inscribed "Provisional Edition" on the assumption that the individual countries would ultimately produce official definitive editions. The Map has received the enthusiastic support of the Pan-American Institute of Geography and History, and in 1941 the American Geographical Society's proposal to undertake the publication of an Atlas of the Americas to include physical, social, and economic geography was unanimously approved by the Institute.

Mr. Platt gives an interesting account of experience in obtaining and appraising the material from which the sheets were compiled. Where possible the map is based upon rigorous instrumental surveys: these are contained in two classes of documents—published surveys in sheet or atlas form issued by official bodies or contained in books or scientific periodicals, and unpublished surveys in the archives of government departments, scientific institutions, and development companies. In the first class, no general catalogue of the existing material was available, and a necessary adjunct of the work was the preparation of one based on the collections of the American Geographical Society and of certain public and university libraries. To locate and obtain the material in the second class was even more laborious, but owing to the international support which the project received it is believed that for most sheets all but a small percentage of these surveys were made available to the compilers. It is of interest to note that the development companies, railway, mining, and the like, provided the greater contribution of high-grade topographical survey, covering a much wider area than official surveys.

Despite the large amount of material obtained from these sources, numerous blanks of varying size had to be filled, and recourse had therefore to be made to existing compiled maps and to descriptive literature. During the second half of the nineteenth century, general maps were published of some Caribbean and west coast countries such as Raimondi's map of Peru and Wolf's map of Ecuador. This type of map generally contained some actual survey, usually by rapid methods, and it was necessary to determine the reliability of this work, and the extent to which the map incorporated information outside the personal knowledge of the compiler. It was also found possible, from a study of physiographic descriptions in conjunction with existing topographical surveys, to

delineate satisfactorily a wider area than that covered by the survey. By the use of suitable conventional signs and a reliability index the value of the material incorporated in each sheet is clearly indicated.

In the course of the work it was revealed that much good material existed which had never been used for published compiled maps. The course of the Amazon above Manaus had usually been based upon a survey of 1848, although a large-scale chart maintained up to date by a steamship company was in existence. Other material, *e.g.* the maps of the Intercontinental Railway Commission covering the area from Guatamala to central Bolivia, and Tippenhauer's contoured survey of large areas of Haiti, had similarly been neglected. As Dr. Bowman has remarked, "The Millionth Map of Hispanic America has taken a continent and a half out of a state of cartographic disorder into one of order, and thus it has so far advanced the world map that the urge to complete it is now higher than ever." G. R. C.

GEOGRAPHY IN THE UNIVERSITY OF NEW ZEALAND

The opening of the university session in February 1946 marked an epoch in the development of geographical science in the Dominion of New Zealand. In the first century of European settlement in New Zealand, geography had little or no place in the higher educational system. The most prominent names associated with the geography of the country in earlier years are those of continental scientists who so largely described and interpreted the New Zealand scene in the Humboldt tradition. Such names include those of Hochstetter, Dieffenbach and Von Haast. The study of geography was subsequently in the hands of eminent natural scientists, and their contributions were essentially to the systematic aspects of physical geography. Such was the work of Cockayne, the plant ecologist, Kidson, the meteorologist, and Marshall and Cotton, the geologists and geomorphologists.

It was largely in response to demands for qualified school teachers of a subject of growing influence and interest in the primary and secondary school curricula that the first university department of geography was established. The initial development occurred in 1937 at Canterbury University College when geography was first taught beyond the first-year stage for the Bachelor of Arts Degree under Dr. G. Jobberns. Meanwhile the Senate of the University of New Zealand made provision for geography to be offered for the Degree of Master of Arts (with Honours). Continued demands and the success of the initial establishment contributed to the decisions of the authorities to establish in 1946 independent departments of geography at Auckland University College and in the University of Otago, and to institute a lectureship in geography at Victoria University College.

Dr. Kenneth B. Cumberland, formerly at University College, London, and more recently Senior Lecturer in Geography at Canterbury University College, has been appointed head of the new department at Auckland. In the University of Otago, Mr. B. J. Garnier has been appointed Lecturer in Geography; and Mr. D. W. Mackenzie has been elected to a similar post at Wellington. The continued and increasing popularity of the subject is revealed in the number of students taking geography in the four university centres. At Canterbury University College, for example, some twelve students are doing post-graduate work in geography; at Auckland University College the first-year class alone totals two hundred students.

These developments mark the end of the period of apprenticeship of geography as a university study in New Zealand. With the founding of the New Zealand Geographical Society two years ago, and its successful publication of an

attractive academic journal, the *New Zealand Geographer*, the subject has now been launched firmly and confidently on a path of service and research at the highest level of educational attainment in the Dominion.

CATTLE STATIONS IN THE AUSTRALIAN MONSOONAL ZONE

In an article entitled "Settlement in the Eastern Kimberleys, Western Australia" (*The Australian Geographer*, June 1945), Wilson H. Maze has given a precise account of the state of the country and the position of the cattle industry in the hinterland of Wyndham, Western Australia, after some sixty years of pastoral occupation.

The Eastern Kimberleys of this paper are the lands of the Ord River and its tributaries, which Mr. Maze visited in 1944. The scope of his work, and the problem to the solution of which it will undoubtedly contribute, are best explained by a few quotations. The following are Mr. Maze's own statements, though not in his sequence: "The Eastern Kimberleys [Western Australia] and the Victoria River basin [Northern Territory] have been settled as one unit and together form a compact natural region developed almost entirely for the cattle industry . . . and any plans for more intensive development of the Ord River area, must be considered in their relationship to the whole region. . . . The first cattle introduced into the Ord River district were overlanded from Queensland by M. P. Durack in 1883. The region was then occupied by a considerable aboriginal population and the pastures were grazed only by the soft-footed marsupials. By 1890 the greater part of the East Kimberley area was officially occupied on a leasehold basis. . . . The tendency has been for the owner-occupier to disappear, and for company management to expand. . . . With few exceptions the cattle industry is in the hands of five large pastoral companies. . . . The pastoralists have in general exploited the resources of soil, grass, water and black labour with a minimum of effort and capitalization . . . one or two of the larger pastoral companies practically control the economy of the whole area. . . . The state of the cattle industry can be judged from the fact that the annual cattle crop is 10 per cent. or less of the total number of branded stock carried and of the cattled treated at Wyndham meatworks less than 10 per cent. is of first-grade or chiller quality. . . . To-day the aboriginal population in the settled areas is the station blacks and their dependents, most of whom have been born and bred on the stations."

Through his field-work Mr. Maze has been able to distinguish and to map twelve types of landscape in the region west of the Victoria River, and his analysis of the rainfall records of six widely separated pastoral stations gives a fair picture of seasonal conditions. He concludes that the factor now limiting the development of the cattle industry is the occurrence of a "starving period." "During October every year all cattle experience a period of semi-starvation. The longer the opening of the wet season is prolonged the more acute the starvation becomes."

The possibility of supplementary feeding during the starving period is considered. The experience of the station gardens shows that fodder crops might be grown on a limited scale, under irrigation; and places suitable for local schemes of irrigation appear to exist on the Ord River and some of its tributaries. The regime of the Ord however is peculiar, and the amount of material transported during flood suggests that the rate of silting of impounded water would be very high. "The remarkable results which have been achieved in herd improvement on quite a large scale by several of the smaller stations are indicative of what could be expected from the whole area."

The Carr Boyd Range and a gorge through which the Ord flows before it

turns towards Wyndham, both important in Mr. Maze's discussion, are not marked on his maps; but they show the Joseph Bonaparte Gulf, a name revived on Australian maps as long ago as 1921 but not yet admitted into Admiralty publications. M. A.

OBITUARY

AHMED HASSANEIN PASHA

Ahmed Hassanein's death in Cairo on February 19 as the result of a motor accident has deprived the Society of a most distinguished Fellow, geography of a great explorer and traveller, and his many friends of most pleasant companionship. To me in particular it means a personal loss greater than I can properly express. We had been in close contact since our days at Balliol College before the 1914–18 war. We met again in 1917, spending nearly three happy months at Tobruk helping Colonel the Hon. M. G. Talbot to negotiate on behalf of His Majesty's Government and, to some extent, the Italian Government a peace settlement with Sayid Idris el Senussi which was to bring to a conclusion the Western Desert campaign in Egypt instigated by the Turks and led by Seyid Ahmed el Senussi, whose defeat in the Siwa-Giarabub area effectively brought the campaign to an end. In the following years in Cairo and throughout the years which followed until his death we remained in close contact and hoped as contemporaries to continue this until the end of our normally appointed days.

Ahmed Hassanein was a scholar, athlete, and gentleman of quality by the highest standard of any nation or time. His lithe, quick body and mind had made him one of the outstanding fencers of his generation: he represented Oxford University in the epée style of fencing but he was also an adept in other branches of the art and had tried his hand with success at other forms of sport, especially tennis and boxing. Of Badawin ancestry, he always kept his interest in the Badawin life, and it was not surprising that with the common interests we had, the opportunity of our stay at Tobruk should have been used to lay the plans for an exploration of the Kufra Oases, which up to that time had been visited by only one European expedition, that of G. Rohlfs in 1879, and by no other educated travellers and geographers. A few Italian prisoners of war, taken during the campaigns in the early part of the 1914–18 war and before, and one French prisoner had sojourned at Kufra, but the accounts which they brought back were of little value compared with what Rohlfs had secured and with what remained to be done. We had intended that journey together, but, as it fell out, Ahmed Hassanein was accompanied by Mrs. Rosita Forbes in the first great journey into the Libyan Desert which he made in the winter of 1920–21. This journey was made in arduous and difficult circumstances, due not only to the prodigious effort of the camel journey from the Aujila to the Gialo oasis but also to the lightness of the equipment which the travellers were able to take having regard to the difficulties of arranging such an expedition, which required both the permission of the Italian authorities to travel in the coastal districts and that of the Senussi for a journey farther inland which the Italians were loth to see any one undertake. The journey, sensational and successful as it was, served only to whet Ahmed Hassanein's appetite for more. He wished, as every explorer wishes, to see what was beyond. And what was beyond was then

entirely unknown to educated man. He set out on his second expedition alone, reached Kufra for the second time in March 1923, and went on south, bringing back the first account and sketch-maps of the Jebel Archenu and Jebel 'Uweinat on the nominal border between Libya, the Sudan, and Egypt. Apart from the geographical data obtained on this remarkable journey Ahmed Hassanein brought back ethnological information of considerable value. His work was the foundation of all the further journeys by British and Egyptian travellers in the south Libyan Desert. For this journey Ahmed Hassanein was awarded the Founder's Medal of the Royal Geographical Society in 1924. He gave an account of his journey in an Address to the Fellows of the Society on 19 May 1924; a full account was published in the *Geographical Journal*, 54 (1924) 273–291 and 353–366.

In the years which followed Ahmed Hassanein took up and developed his part in Egyptian public life, mainly at Abdin Palace with His late Majesty King Fuad and subsequently with his son the present King of Egypt whose tutor and mentor Ahmed Hassanein was during the latter period of his education in England. But Hassanein was more than a courtier or a King's Chamberlain—he was the friend and advisor of Egyptians and British in Cairo alike, respected by both and trusted by all.

Those who like myself looked forward for him to a valuable and long life have as much to regret in his death as a friend, as in the loss of a man who had contributed and was going to contribute immensely more to Anglo-Egyptian relations.

Some of the pleasantest of my recollections of the 1914–18 war were dinners in the garden of the house in Bulaq where Hassanein's family had lived and where his Circassian cook produced exquisite food under a moon-lit palm tree. If those days were not to be renewed we who enjoyed them at any rate preserve the recollection of a great friend and a most pleasant companion which nothing in this life ever marred. R. OF R.

CORRESPONDENCE

THE EVIDENCE FOR A FORMER GLACIATION IN THE SOUTH-WEST PERSIAN MOUNTAIN BELT

In 1934, after a short visit to the northern side of Zardeh Kuh in the Bakhtiari mountains, a paper was published by Professor A. Desio in which the presence of small glaciers was recorded, and a strong plea made for a former more extensive glaciation, based on the distribution of moraines and terraces ("Appunti geografici e geologici sulla catena dello Zardeh Kuh in Persia," *Mem. Geol. e Geogr. di Giotto Dainelli*, vol. IV, Firenze, 1934).

During 1930 and 1931 I had assisted Dr. J. V. Harrison and Mr. A. H. Taitt to make an extensive geological reconnaissance survey of the Bakhtiari mountains for the Anglo-Iranian Oil Company, which resulted in the preparation of a geological map on the scale of 4 miles to 1 inch. This comprehensive experience made it difficult for me to accept Deslo's argument for a former glaciation as I found it hard to believe that the combined knowledge of our party had overlooked any important evidence. In the autumn of 1935 therefore I made an opportunity to revisit Zardeh Kuh and see for myself the area examined by Desio. It seems desirable that the results of this visit should be placed on

record, so that geographical compilers should be aware of both sides of the question.

While I agree with Desio that there are small masses of stagnant ice of no great thickness in hollows on the north side of Zardeh Kuh, with moraine-like masses associated with them, I am doubtful if it is wise to dignify them by the name of glaciers. I suggest it would be better to use Priestley's term "snowdrift ice" or Drygalski's useful "niche glacier." The moraine-like masses associated with these ice patches may be explained by the following quotation from W. B. Wright's 'The Quaternary Ice Age' (p. 6). "The most diminutive type of glacier is merely a snow slope lying against some steep face of rock. This is often surrounded by a ridge of debris having somewhat the appearance of a moraine, but really formed only of scree which has slid down over the snow from the rock above." When rockfalls are involved this morainic appearance is accentuated. It does not seem probable that true moraines are present for there is no room for any appreciable ice movement to have occurred.

On the evidence for a more extensive glaciation I can not agree with Desio. Although there can be no doubt that the present ice patches were once of greater extent, they never in my opinion graduated to the glacier class, and were never more than local in effect. The evidence cited can all be explained by other geomorphological processes. The introduction of the Tembi and Galli Gahar lakes into the argument merely weakens it, for Desio has not seen them; we have, and unhesitatingly ascribed them to rockfalls.

Two examples of old moraines for which Desio gives photographs (Figs. 2 and 18) appear to be normal talus deposits, and both have their apices in acute V-shaped valleys cut by water erosion in the upper (*i.e.* outer) limestone sheath of the mountain. The third example (Fig. 20) is almost certainly an accumulation of debris in an area prone to avalanches and rockfalls.

In conclusion I would particularly refer to the erratic figured by Desio (Fig. 19). Blocks of this sort are not uncommon in the Persian mountain belt and can be found in situations where glaciation is out of the question. For example there are similar impressive blocks in the terminal part of the debris of the great Saidmarreh rockfall, where they lie 7 miles from their origin (see *Geogr. J.* 89 (1937) 44–47). N. L. FALCON.

16 *March* 1946.

MEETINGS: SESSION 1945–46

Eighth Meeting, 7 January 1946. The President in the Chair

Elections: Miss Margaret Alford, B.A.; Miss Marjorie Helen Anderson, B.SC.; Miss Joan Elizabeth Burton; Captain William Olton Butler, R.A., B.A.; Miss Elizabeth Mary Buxton; Dr. Percy Robert Crowe, B.SC., PH.D.; Dr. Elwyn Davies, M.A., M.SC., PH.D.; William Leslie Nuttall Dundas; Group-Captain F. F. Fulton, O.B.E., R.A.F.; John W. Gardner; Miss Betty Gill, B.A.; Miss Joan E. Harris, B.A.; The Rev. Frederick Charles Haysmore, B.D.; Professor Vincent C. Illing, M.A., F.R.S.; William J. W. Johnson, B.SC.; Frederick Gordon Kay; G. E. D. Lewis, B.SC.ECON.; Robin Wallace Stuart Livingstone; Captain Athelstan Charles Ethelwulf Long, R.A., M.A.; Major William James Standen Mills, R.A.; Miss G. Owen-Jones; Harold Frank Pearmain, M.A.; Gordon Evelyn

Gilbert Plant; The Rev. Swami Pranavananda; Robert Shaw; Miss Iris Sylvia Soanes; Captain William Spensley; Henry Hector Starr, M.SC.; Wing-Commander John William Stewart, R.A.F.V.R.; Alwyne Nicholson Thomas, B.SC.; Captain Thomas Tod; Miss Dorothy Margaret Trevor; A. Walford; Mrs. Marion K. Wilberforce; Eric Archibald Willis, B.A.; Lt. John Wilson

Paper: The gateway to the east. By Sir Leonard Woolley

Ninth Meeting, 14 January 1946. Dr. Hugh Scott in the Chair

Geographical Films: India. Kodachrome films with commentary by Sir Clarmont Skrine

Tenth Meeting, 21 January 1946. Mr. Leonard Brooks, Vice-President, in the Chair

Paper: Geographical values in south-east Asia. By Mr. E. H. G. Dobby

Eleventh Meeting, 28 January 1946. Mr. Leonard Brooks, Vice-President, in the Chair

Geographical Films: In northern waters. Kodachrome films of Iceland, Norway, and Denmark, with commentary by Mr. F. R. Newens

Twelfth Meeting, 4 February 1946. The President in the Chair

Elections: Marcel Aurousseau, M.C., B.SC.; William Herbert Crampton Bailey; Arthur Warden Baker; Brig. N. L. St. Pierre Bunbury, D.S.O.; Miss Alice Beryl Carson; Professor V. J. Chapman; Charles Harold Cottew, A.M.INST.C.E.; H. J. Covell; Michael George Marsh Crosby; Captain Alfred Maurice Davis, O.B.E.; Philip George Murgatroyd Dickinson; Lieut. Malcolm J. Luxmoore Duff, R.N.; Lieut. J. Eastwood, R.SIGS.; The Rev. Fred Owen Gardner; Lieut.-Col. I. F. G. Hall; Percy Valentine Harris; Douglas Neville Kendall, O.B.E.; Mrs. Phyllis M. Lake; Major Ian Hallam Lyall Grant, M.C., R.E.; Miss Joan A. McDonald, B.SC.; Captain John McNaughton; The Rt. Hon. Lord Nathan of Churt; Mrs. D. V. Paterson; Gibson Pattison; Lieut. Gerald Richards, R.N.V.R.; Hubert E. Ricks, M.A. LL.B.; Group-Captain P. J. A. Riddell, C.B.E., R.A.F.; Roger Scrase Rothwell, B.A.; Mrs. Brenda M Ruffell; Captain George Franklin Spooner; William Clarence Stokes; Captain T. L. Thomas, M.B.E, B.SC., R.E.; 2/Lt. H. R. Thompson; George John Turner, M.A., B.SC.; Kenneth Whitaker; Lieut.-Col. Sidney William Maurice Whitehead, R.A.

Paper: High latitude flying by Coastal Command in support of Russian convoys. By Air Chief-Marshal Sir Philip Joubert and Lieut.-Commander A. R. Glen

Thirteenth Meeting, 18 February 1946. Mr. J. M. Wordie, Honorary Secretary, in the Chair

Paper: Technical aspects of *Aries* flights. By Wing-Commander K. C. Maclure

Published July 1946